2013 Multi-State Land Use Study: Estimated Land Use Changes 2007-2012

Prepared for:

Minnesota Farm Bureau

South Dakota Farm Bureau

Iowa Farm Bureau — People. Progress. Pride.

Illinois Farm Bureau — Farm. Family. Food.

Nebraska Farm Bureau

Indiana Farm Bureau

Michigan Farm Bureau

Prepared by:

Decision Innovation Solutions — Bridging Your Research Needs.

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Legal Disclaimer

Decision Innovation Solutions, LLC ("DIS") has prepared this analysis (the "Project") for review and use. The Project consists of an estimation of historical land use patterns as well as possible contributors to these changes in land use patterns in 7 states within the Midwestern region of the United States.

While DIS has made every attempt to obtain the most accurate data and include the most critical factors in preparing the Project, DIS makes no representation as to the accuracy or completeness of the data and factors used or in the interpretation of such data and factors included in the Project. The responsibility for the decisions made by you based on the Project, and the risk resulting from such decisions remains solely with you; therefore, you should review and use the Project with that in mind.

While the Project does include certain estimates and possible explanations for changes in land use patterns, it cannot be ascertained with certainty the extent to which these estimates are entirely accurate. The following factors, among others, may prevent complete accuracy of the estimation of changes in land use patterns and explanations for the same:

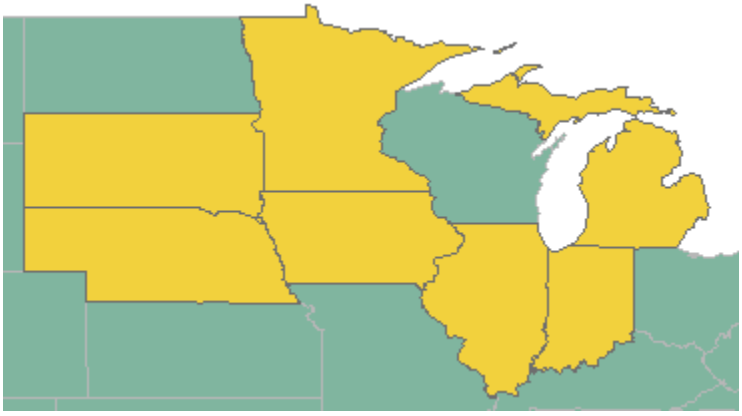
- Inadvertent errors and omissions related to data collection, data summarization, and visual display of data;
- Technological and/or agronomic advances in the use and production of crops produced in the study area that may affect estimation of crop production economics.

Table 1, Acronyms

Acronym	Description
USDA/NASS	United States Department of Agriculture, National Agricultural Statistics Service
USDA/FSA	United States Department of Agriculture, Farm Service Agency
CRP	Conservation Reserve Program
CDL	Cropland Data Layer

Executive Summary

This 2013 Multi-State Land Use Study was commissioned by seven state Farm Bureau organizations in the Midwest. The states included in this analysis are shown below.



The primary purpose of this study is twofold: 1) provide estimates of the degree to which land use changes have occurred in many Midwestern states; and 2) identify potential factors contributing to these land use changes. To accomplish this twofold purpose, this analysis has utilized a variety of analytical techniques, tools, and datasets and was performed with the time period 2007-2012 as the frame of reference.

Given the importance associated with a critical limited resource such as land, context is of utmost importance when undertaking a study such as this. Understanding what is happening contextually allows those seeking to understand changes in land use patterns to not only grasp what has actually occurred, but what may have contributed to that change. Since approximately 2005, focus on land use issues has centered on the extent to which land is being converted to the production of crops, and even more specifically, the major program crops and those crops for which there is crop insurance coverage.

The issue of land use change is of great importance in the Midwest. Due to its prime location and possession of some the most productive soils in the world, the issue will certainly be discussed for years to come. In order to adequately address land use challenges it is imperative to have an accurate understanding of what has occurred, as well as what may have contributed to the myriad of land use changes which have occurred over time.

The 2013 Multi-State Land Use study yielded many interesting results with policy implications. Our spatial analysis yielded results that support the perception that land use continues to evolve in the Midwest, just as it has done for centuries. The nearby table shows a summary of our estimates of net

land use change during the 2007-2012 timeframe based on satellite imagery. As shown, the total net change across the entire 7-state study area was 8.534 million acres. This represents 3.0 percent of total land in the 7-state study area. The majority of this net change was toward Corn (3.605 million), Soybeans (2.175 million), Alfalfa (1.278 million), and Small Grains (1.254 million). In the case of Grassy Habitat to Non Ag, a negative number is shown; this represents a net movement of acres toward Grassy Habitat.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): 7-States	Net Change
Grassy Habitat to Corn	3,604,683
Grassy Habitat to Soybeans	2,174,547
Grassy Habitat to Alfalfa	1,277,765
Grassy Habitat to Small Grains	1,253,530
Grassy Habitat to Other Ag	156,421
Grassy Habitat to Other Oilseeds	139,503
Grassy Habitat to Woody Habitat	112,500
Grassy Habitat to Non Ag	(185,339)
Net Change FROM Grassy Habitat	8,533,610

One of the key findings of this research with regards to spatial implications is the degree of value gained from using CDL data for decision making. While the data have been improving over time and continues to increase its ability to guide the policy decision making process, there are still errors in how certain types of land covers are identified, particularly those which are either comparatively observed less frequently or are more grassy in nature. To base policy decision solely upon results from CDL data can lead to less than optimal outcomes with regard to land use patterns.

A key finding of this research with regards to econometric implications is that land use is a very complex issue that cannot be reduced to a few variables. In particular, our economic research does not support the notion that crop insurance subsides and net returns alone are the dominant factors contributing to loss of Grassy Habitat, especially when observed from a regional perspective.

Both spatial and econometric results have led to questions that could be the subject of additional research in the realm of understanding Midwestern land use patterns. These areas for further consideration include: 1) the expansion of crop production beyond traditional growing areas; 2) the impact of elevated crop prices and returns on land use change; and 3) the future of land stewardship efforts and programs.

Introduction

Project Scope

This 2013 Multi-State Land Use Study was commissioned by seven state Farm Bureau organizations in the Midwest. The states included in this analysis are shown in Figure 1.

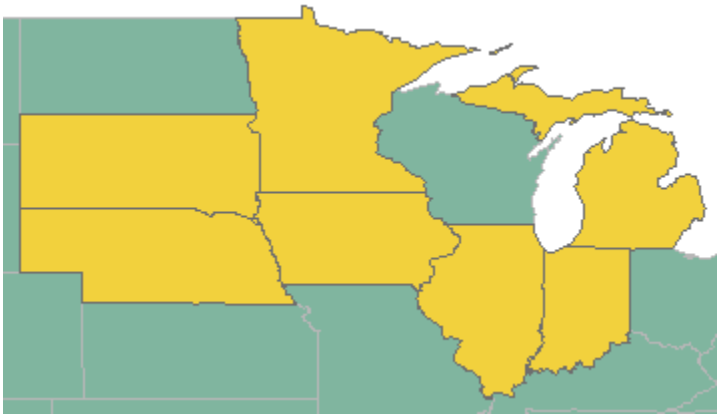


Figure 1, 7-State Study Area

The primary purpose of this study is twofold: 1) provide estimates of the degree to which land use changes have occurred in many Midwestern states; and 2) identify potential factors contributing to these land use changes. To accomplish this twofold purpose, this analysis has utilized a variety of analytical techniques, tools, and datasets and was performed with the time period 2007-2012 as the frame of reference.

Contextual Overview

Given the importance associated with a critical limited resource such as land, context is of utmost importance when undertaking a study such as this. Understanding what is happening contextually allows those seeking to understand changes in land use patterns to not only grasp what has actually occurred, but what may have contributed to that change.

As in other geographies and time periods throughout the history of the United States, land use continues to evolve in the Midwest. During early colonization years prior to the expansion west in the 19th century, the Midwest's primary land cover was prairie grassland. As westward expansion occurred, a large share of this native prairie was converted to other uses, such as urban expansion and the production of crops.

Since approximately 2005, focus on land use issues has centered on the extent to which land is being converted to the production of crops. In some cases it is argued that the conversion of non-cropland has come at the expense of native prairie, while other sources of converted cropland has been land which has historically been used at some point for producing crops (i.e., pasture, acreage enrolled in the Conservation Reserve Program, etc.).

Conservation Reserve Program

Land use change is driven by a variety of factors. However, it has been postulated that a primary driver of land use change in the last decade is elevated crop prices and associated economic returns for landowners. Returns to landowners for the production of crops, in many cases, significantly exceeds returns from the receipt of annual Conservation Reserve Program (CRP) rental payments or the receipts that can be derived from alternative uses such as pasture. Given the fact that much of the currently enrolled CRP acreage was used in an active crop production environment prior to the creation of the CRP program in 1986, it is a reasonable assumption that a portion of this land is suitable once again for producing crops.

The original form of the CRP program was designed for "whole farm" enrollment, which means that whole sections of land, regardless of the variation of the land's characteristics, were submitted for enrollment. Oftentimes, a significant portion of the land from these whole farm parcels was suitable to continue in active production. Given technological advances in crop production techniques and improved land stewardship practices, this is especially true in 2013.

If elevated prices and returns persist, economic pressure will continue to have an influence on the decision to enroll or re-enroll acres in the CRP program, especially those acres which are less environmentally sensitive. However, due to the extreme environmentally-sensitive nature of some acres enrolled in the CRP program, some acres will likely never be suitable for actively producing crops, regardless of their crop production history.

CRP as a Commodity Supply Control Mechanism

In 1986, toward the end of the acute part of the farm crisis in the early to mid-1980s, the Conservation Reserve Program (CRP) began with a two-fold mission: 1) act as a commodity supply control mechanism and 2) protect environmentally-sensitive lands.

In the mid-1980s, farmers were experiencing depressed commodity prices and had endured severe financial hardship from the farm crisis of the early 1980s. By allowing farmers to "set aside" their farms

in exchange for regular monetary payments for a specified period of time, supply of excess commodities were reduced and prices for major commodities found a degree of support. Most notable during this time period were the 1986 and 1987 sign-ups in which more than 21 million acres of cropland were enrolled.

CRP as an Environmentally-Sensitive Land Protection Mechanism

According to the USDA/Farm Service Agency (2010):

> "Title XII of the Food Security Act of 1985 established the Conservation Reserve Program (CRP) to assist owners and operators in conserving and improving soil, water, and wildlife resources on their farms and ranches by converting highly erodible and other environmentally sensitive cropland and marginal pasture to long-term resource conserving covers. In exchange for annual rental payments and cost-share assistance of up to 50 percent of cover establishment costs, agricultural landowners and operators agree to establish and maintain an approved permanent cover on enrolled acreage for 10 to 15 years. The 1985 Act directed the Department of Agriculture to enroll 40 to 45 million acres by 1990 with a primary goal to reduce soil erosion on highly erodible cropland. Secondary objectives included; protecting the Nation's long-run capability to produce food and fiber, reducing sedimentation, improving water quality, fostering wildlife habitat, curbing production of surplus commodities, and providing income support for farmers."

As the CRP program has matured, the cap on number of acres nationally has varied, as well as the requirements which must be satisfied for admission into the program. The first general CRP sign-up period was in early 1986. Since that time, there have been 44 sign-up periods for CRP. The general sign-up for CRP is a competitive process, which means that not all land offered for enrollment in CRP will be accepted. The length of a CRP contract is generally ten years unless the land will be devoted to certain wildlife practices, in which case a participant may select a 15-year contract. The most recent general sign-up (sign-up 45) was for the May 20, 2013 through June 14, 2013 time period.

Beginning in 1997, landowners have had the option of submitting acres for inclusion in continuous CRP, which is a targeted (from a sustainability standpoint) program designed to protect the most sensitive lands from degradation. The continuous CRP program addresses the whole farm issue present in the general CRP program in that only lands that merit a higher degree of environmental protection are

accepted. Notably, the annual rental payments for the continuous CRP program are typically higher than their general CRP counterparts.

While there are stiff financial penalties for breaking a CRP contract (at a minimum, all prior payments received under the contract must be repaid), there are opportunities for exiting the program upon contract expiration. As noted earlier, contracts are typically ten years in length. Below, in Figure 2, is shown the cumulative total acreage enrollment in CRP from its inception in 1986. As can be seen, the trend of late is a decline in total acreage enrolled in the overall CRP program, but an increase in continuous CRP. This trend coincides with both a large number of acres reaching contract expiration and elevated economic returns for producing crops. Current total CRP acreage is at the lowest level since 1999. Total CRP acreage peaked in 2007 at nearly 37 million acres. Acreage enrolled in the CRP program in 2012 represents 5.5 percent of total farmland in principal crops in the study area.

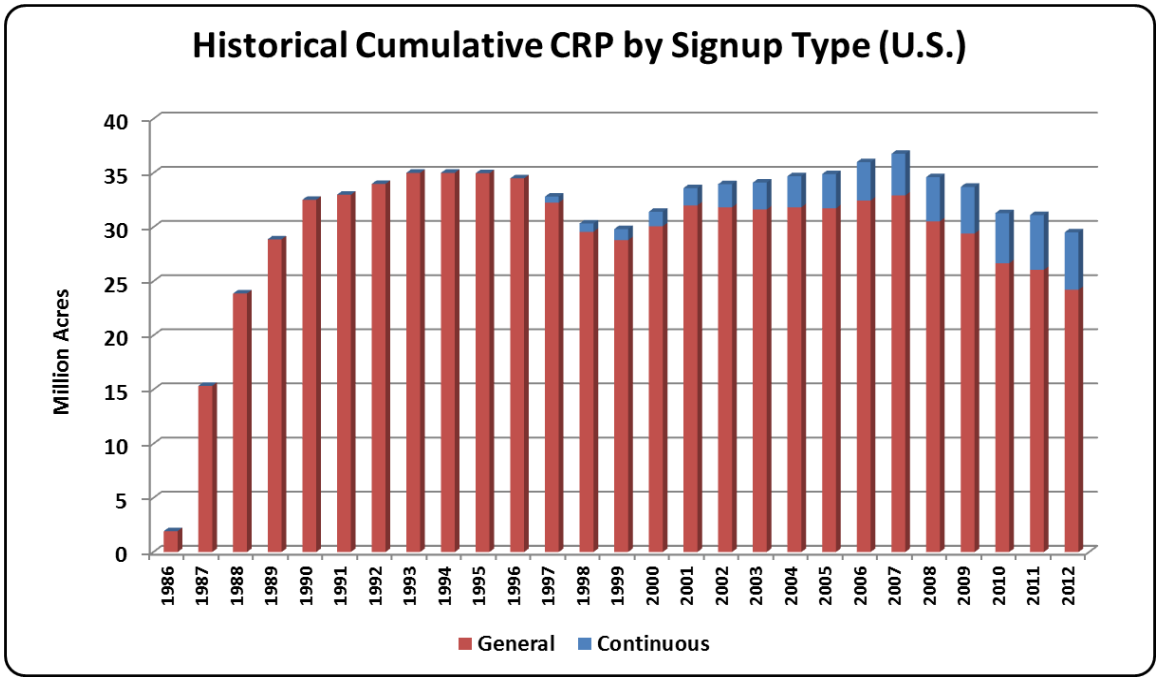


Figure 2, Historical Cumulative CRP Acreage (U.S.)

There are many, and often significant factors (i.e., water rights, water availability, returns from competing agricultural endeavors such as livestock production, etc.), influencing landowners' decision-making process regarding the use of their land. However, for the purpose of this study, we have chosen to better understand the role crop production economics plays in the land use decision. We have chosen this as our focus because on the surface it appears to be the most influential factor affecting agricultural land use decisions.

Methodology

The 2013 Multi-State Land Use study consists of two major components: 1) Spatial Analysis, and 2) Econometric Analysis. Below are details regarding the methodology employed, data used, and implications surrounding the choice of methodology and data used in this analysis.

Spatial Analysis

The spatial analysis component of the 2013 Multi-State Land Use study seeks to answer the question of what types of land use change have occurred from 2007 to 2012. Specific data have been identified and used to answer this question and is detailed below.

Data Description

The single most important data source for the spatial component of the 2013 Multi-State Land Use study is the USDA/National Agricultural Statistics Service (USDA/NASS) Cropland Data Layer (CDL) dataset. Depending on the state in question, there are varying degrees of historical data available. In order to accurately compare states across time, the identification of a common time frame was necessary. For purposes of this analysis, the time frame selected was 2007-2012, which allows for the analysis of five annual changes in land use.

Annual data in the USDA/NASS CDL has historically provided estimates of land use in about 130 possible land cover types across the United States. Geography necessarily precludes any one area from having all possible land cover types present in a given area. Because the degree to which the CDL data are classified is computationally intensive, we have aggregated the universe of land use types into nine categories, which are detailed in Appendix A. Below are the nine land use categories used in this analysis:

1. Corn
2. Soybeans
3. Other Oilseeds
4. Alfalfa
5. Small Grains
6. Other Ag
7. Grassy Habitat
8. Woody Habitat
9. All Non-Ag

Spatial Analysis Methodology

As of 2007, all Midwest states have had annual data from the USDA/NASS CDL collected. Because the USDA/NASS began to make available universal coverage in 2007 for the states under study, the time frame of 2007-2012 (most recent available) is the most broad analysis that could be undertaken. The

resolution of the annual data was not consistent, so all years were resampled to 100 meter resolution to get a consistent resolution across all states and years.

Using ArcView 10.1, the USDA/NASS CDL data were re-classed to nine aggregation categories from over 130 land types in the CDL data. Once this was completed for both the 2007 and 2012 raster sets, the 2012 values were subtracted from the 2007 values to determine the land use change, if any, which occurred during the six-year period. Doing this created 73 possible land use change outcomes. Once the raster datasets were combined to determine change, the raster was converted to a polygon dataset to calculate the areas of each individual land use change.

To determine individual county data, each county was clipped out of the statewide polygon for each year to determine changes. Individual county files were summarized according to each possible land use change and then exported to be used in SAS software for the summarization of county-specific data. State totals were also calculated.

The above process was repeated for each of the seven states under study for each of the interim years between 2007 and 2012. These results were then made available for use in the Econometric Analysis component of this study. The only difference in the interim year analysis is year-to-year changes were not determined on a specific geographic point. Each year was summarized by the nine aggregation categories and the total area for each category was determined for each county.

An important point worth mentioning regarding the spatial analysis methodology is that, whereas some analyses have endeavored to understand habitat acreage changes from a "converted from habitat" basis, we have analyzed land use changes on a net basis. In other words, our null hypothesis for this research provided for the assumption that land use changes can move both directions (both to and from habitat). To not account for land use changes on a net basis, in our opinion, would produce research and results that could be biased, marginalized and rendered useless, or worse yet, lead to inaccurate conclusions regarding the magnitude of land use changes that are occurring and the drivers of land use change. Our goal has been to provide a rigorous analysis that withstands scrutiny.

Data Accuracy

The spatial analysis was initially undertaken with the assumption that sampling errors in the CDL data were similar to other data collection methods undertaken by USDA/NASS. After reaching preliminary conclusions regarding the degree to which land use had changed within the study area, the accuracy of CDL data was called into question. In particular, it became apparent that some types of land covers

were sensed and/or classified inconsistently or inaccurately. The classification process improved over the course of our study period. For instance, in our first round of spatial analysis we had included a CDL-designated land cover called "Pasture/Grass" in our "Habitat" aggregation category. Michigan data shown in Table 2 illustrates that this land cover type was brought to zero by 2009.

State	CDL_Code	Aggregation	Land Cover	2007	2008	2009	2010	2011	2012
MI	36	Alfalfa/Hay	Alfalfa	671,209	778,738	637,698	1,457,712	1,094,902	1,049,819
MI	37	Alfalfa/Hay	Other Hay/Non Alfalfa	1,516	309,771	-	642,689	514,988	480,695
MI	181	Alfalfa/Hay	Pasture/Hay	-	1,724,395	2,039,218	1,313,221	2,075,090	1,977,482
MI	63	All Non-Ag	Forest	6,573	-	-	-	-	-
MI	141	All Non-Ag	Deciduous Forest	10,795,549	10,389,263	10,566,998	10,435,082	10,781,017	10,718,263
MI	142	All Non-Ag	Evergreen Forest	2,041,096	2,078,341	1,989,809	2,070,077	2,072,168	2,047,809
MI	143	All Non-Ag	Mixed Forest	952,960	1,051,176	1,035,364	1,074,605	922,361	959,037
MI	1	Corn	Corn	2,801,323	2,875,388	2,588,115	2,711,864	2,530,563	2,783,077
MI	62	Habitat	Pasture/Grass	1,522,507	579,726	-	-	-	-
MI	87	Habitat	Wetlands	7,154	-	-	-	-	-
MI	152	Habitat	Shrubland	126,893	134,216	155,183	132,199	168,349	181,314
MI	171	Habitat	Grassland Herbaceous	2,100,013	1,589,035	1,743,411	1,357,636	1,283,438	1,387,088
MI	190	Habitat	Woody Wetlands	7,311,234	7,247,943	7,240,056	7,151,604	7,022,087	6,917,869
MI	195	Habitat	Herbaceous Wetlands	330,586	327,249	328,553	329,001	339,622	396,392
MI	5	Soybeans	Soybeans	1,809,113	2,274,335	2,122,230	2,211,190	1,961,451	1,958,305

Table 2, CDL Data Inconsistencies: Michigan

While not certain, we believe the land in Pasture/Grass land cover type in 2007-2008 was re-classed to a CDL-designated land cover called "Pasture/Hay" in 2009, which was in our "Alfalfa/Hay" aggregation category. We believe this was the case because of the closeness of totals in each of the CDL-designated land covers. This change in classification led our original analysis to erroneously conclude that there was a more than 1.5 million acre shift of land from "Habitat" to "Alfalfa/Hay", even though much, if not all, of the land was likely being used for the same purpose in 2012 as in 2007.

Remote sensing errors were found in other states in addition to Michigan. For instance, Minnesota data in Table 3 shows how a CDL-designated land cover called "Deciduous Forest" was reduced by more than 4 million acres from 2007-2012. At the same time, a CDL-designated land cover called "Woody Wetlands" was increased by approximately the same amount. Due to how we aggregated CDL-designated land cover types in our original analysis, this led us to conclude that more than 4 million acres had been converted from a "Non-Ag" use to a "Habitat" use, even though the land was likely being used for the same purpose in 2012 as in 2007. Similar results were observed in several other states in the study area during the 2007-2012 timeframe.

State	CDL_Code	Aggregation	Land Cover	2007	2008	2009	2010	2011	2012
MN	36	Alfalfa/Hay	Alfalfa	477,554	299,083	275,174	522,047	1,260,820	1,157,765
MN	37	Alfalfa/Hay	Other Hay/Non Alfalfa	-	-	187,889	114,242	1,028,978	909,692
MN	181	Alfalfa/Hay	Pasture/Hay	-	5,108,894	5,062,816	4,487,898	-	-
MN	63	All Non-Ag	Forest	10,841	10,162	17,599	19,532	-	-
MN	**141**	**All Non-Ag**	**Deciduous Forest**	**13,362,536**	**13,067,912**	**12,913,236**	**12,969,208**	**9,287,577**	**9,259,276**
MN	142	All Non-Ag	Evergreen Forest	3,266,572	3,234,944	3,203,482	3,215,628	1,337,127	1,356,630
MN	143	All Non-Ag	Mixed Forest	15,030	14,297	16,244	15,699	1,343,544	1,326,146
MN	1	Corn	Corn	7,542,827	6,990,791	6,711,205	7,335,567	8,038,260	8,727,601
MN	62	Habitat	Pasture/Grass	2,032,729	1,865,261	1,755,555	2,183,486	-	-
MN	87	Habitat	Wetlands	225,664	12,398	19,435	17,935	-	-
MN	152	Habitat	Shrubland	283,498	185,233	231,422	211,846	607,114	596,711
MN	171	Habitat	Grassland Herbaceous	2,862,900	848,009	971,063	862,428	2,398,777	2,360,833
MN	**190**	**Habitat**	**Woody Wetlands**	**3,040,201**	**3,005,450**	**3,083,934**	**3,101,105**	**7,269,476**	**7,298,791**
MN	195	Habitat	Herbaceous Wetlands	5,387,225	3,297,838	3,392,780	3,194,419	5,248,211	5,491,894
MN	5	Soybeans	Soybeans	5,982,741	6,887,052	7,114,633	7,419,199	7,400,229	6,848,061

Table 3, CDL Data Inconsistencies: Minnesota

After determining the primary causes for our inconsistent spatial results, we determined that it was necessary to adjust our methodology for how we aggregated CDL-designated land cover types. Instead of including forests in a "Non-Ag" category and subjectively dividing CDL-designated land cover types that gave the impression of a cropping aspect (i.e., Pasture/Hay, Other Hay/Non-Alfalfa), we determined to group all "grassy" land cover types together[1]. Hence, we determined that a "Grassy Habitat" and "Woody Habitat" aggregation was the best course of action. By so doing, we were able to address and correct the issue causing misleading results in several states (i.e., Michigan and Minnesota). Further, because our hypothesis is that the habitat acres most susceptible to conversion to crop production are of the grassy-type, we have used the Grassy Habitat aggregation category as our primary area of study.

Grassland Overstatement

In addition to the apparent misclassification of CDL-designated land cover types, there was an underlying issue with the overall acreage classified as grassland within the CDL data. In reconciling USDA/NASS survey data (which has a much lower standard error rate than does the CDL data set) with the annual CDL data, it appears that over the study period (2007-2012) overstatement of grassland has occurred, but is improving (reducing) as the ability to remotely sense land cover improves. In the year 2007, for example, all states except Michigan had a grassland overstatement of at least 1.8 million acres (see Figure 3); some states (Illinois and Iowa) had overstatements of grasslands in excess of 3 million acres in 2007.

[1] Please see Appendix A for complete documentation on revised aggregation methodology.

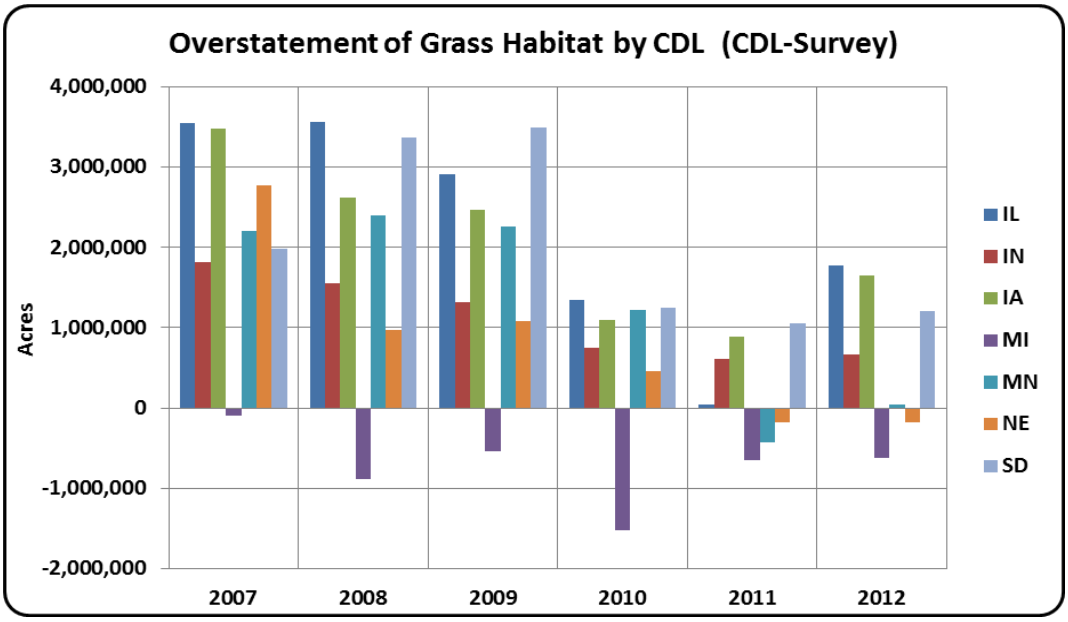


Figure 3, Overstatement of Grass Habitat by the CDL

From a multi-year approach, Figure 4 illustrates the cumulative change in Grassy Habitat change from 2007 to 2012. For example, according to the CDL data, Iowa lost 1.8 million acres of Grassy Habitat from 2007-2012. The NASS survey data, on the other hand, implies that just 3,500 acres of Grassy Habitat were lost during the same time period. The only state within which the CDL data appear to most consistently capture Grassy Habitat change is South Dakota, although a large overstatement of nearly 800,000 acres of lost Grassy Habitat still exists.

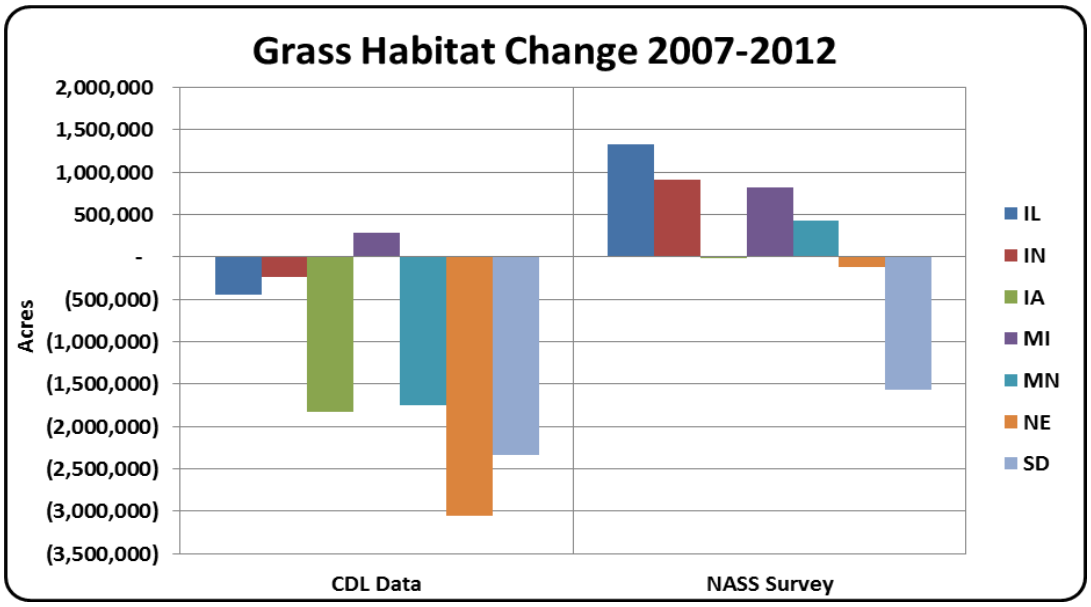


Figure 4, Grass Habitat Change (2007-2012)

While the improvement in the ability to remotely sense land cover is certainly a good thing, this may cause an analysis based solely on CDL data to give inaccurate and/or misleading results and lead to less than optimal policy decisions. The issue with an overstatement of grasslands is that as land cover is more accurately categorized as something other than a grassy-type category, data users are led to believe that more change is taking place than there may actually be. Therefore, one of our primary findings is that great care should be taken in drawing conclusions based upon early CDL datasets, particularly if CDL datasets are the sole source of data.

Econometric Analysis

Data Description

Data for the econometric portion of this study come from sources listed in Table 4.

Data Source	Purpose
Spatial analysis output	Quantification of annual estimated land use patterns
Relevant crop production budgets, various sources	Estimation of returns to crop producers
USDA/Risk Management Agency crop insurance database	Estimation of subsidy rates for federal crop insurance
Iowa Environmental Mesonet	Calculation of Growing Degree days
Iowa Environmental Mesonet	Calculation of Precipitation

Table 4, Data Sources

Econometric Analysis Methodology

In preparation for conducting this econometric analysis, a literature review of a recent Agricultural and Applied Economics Association publications was conducted. As appropriate, methodology was adapted and used for this purpose. This study assesses the impacts of several variables on land use change in the study area with the following model:

$$Y_{it} = \beta_0 + \beta_1 RET_{it} + \beta_2 CIS_i + \beta_3 GDD_{it} + \beta_4 Precip + \varepsilon_{it}$$

Here Y_{it} is the share of land devoted to the Grassy Habitat land use category in county *i* and year *t*; RET_{it} represents a weighted average (by area) net return for cropland; CIS_i represents crop insurance subsidies per acre; GDD_{it} represents total growing degree days; $Precip_{it}$ represents total precipitation; and ε_{it} is the random error term, which can be serially correlated or heteroscedastic. $\beta_0, \dots, \beta_4$ are parameter estimates. The share of Grassy Habitat is derived by dividing total Grassy Habitat area by the total land area in a county for each year.

We assume a key factor that determines Grassy Habitat's share of total acreage is cropland's relative profitability. The profitability of cropland is affected by prices, yields, and production costs. We calculate cropland profitability as weighted average net returns for primary study area cropland (i.e. revenue minus operating costs, weighted by share of cropland devoted to corn, soybeans, and wheat). Expectations are that higher weighted average net returns to the cropland should mean more acreage devoted to cropland and less to Grassy Habitat.

Another key variable of interest is government support as measured by federal crop insurance subsidies. We assume that increased government support increases the share of cropland and hence decreases

the share of habitat. Due to the economic environment present during our analysis time period, many traditional (i.e., counter-cyclical, ACRE, etc.) government payments were not paid. Other government payments such as direct payments were unchanged across the analysis time period and were therefore excluded from the analysis.

We applied an Ordinary Least Squares (OLS) modeling method to construct the regression model specified above. Grassy Habitat's share for each county is linked to weighted average net returns for crops, crop insurance subsidies, growing degree days, and total precipitation.

In the regression equation described above, expectations of the estimated sign for explanatory variables are as follows:

- Net returns for crops would possess a negative coefficient, as higher net returns for cropland would induce higher demand for planting acreage for cropland, causing a decrease of Grassy Habitat acreage.
- The coefficient for crop insurance subsidies would likely have a negative sign, given that a higher government payment tends to encourage more acreage for cropland, causing a decrease of Grassy Habitat acreage.
- The coefficient for the total growing degree days would be negative as higher growing degree days tend to increase crop acreage, which would in turn dampen total Grassy Habitat acreage.
- The coefficient for the total precipitation would be negative as higher precipitation tends to increase crop acreage, which would in turn dampen total Grassy Habitat acreage.

Results

Historically, land use across the 7-state study area is very diverse. Michigan, for example, is one of the most agriculturally-diverse states in the country. Many fruits, vegetables, row and tree crops are produced in Michigan. South Dakota, Nebraska, and Iowa, on the other hand, have a larger proportion of their land devoted to grains and oilseeds. As a result of this diversity across the study area, one would expect results which were as varied as the states themselves.

For the "Results" section of this report, we begin by exploring the 7-state study area as a whole to give readers a sense for what has occurred during the 2007-2012 time period – the spatial analysis. We also visit what variables may have contributed to the land use changes which have occurred during this same time period – the econometric analysis. Following the discussion regarding the 7-state area, we provide similar content for each of the individual seven states under study.

7-State Study Area Results

Background

Acreage to Principal Field Crops

In terms of a historical perspective on the land use in the 7-state study area, acreage devoted to principal field crops (varies by state) for the area has ranged from a low of 117.7 million acres in 1995 to a high of 124.7 million acres in 2000. Estimated acreage farmed in 2012 (124.1 million) is the third highest total since 1993, the first year data of this type were available. Referring to Figure 4, four of the five highest planted acreage amounts occurred during the years 1997-2000. Acres devoted to principal field crops in 2012 represent 44 percent of land acres in the 7-state study area.

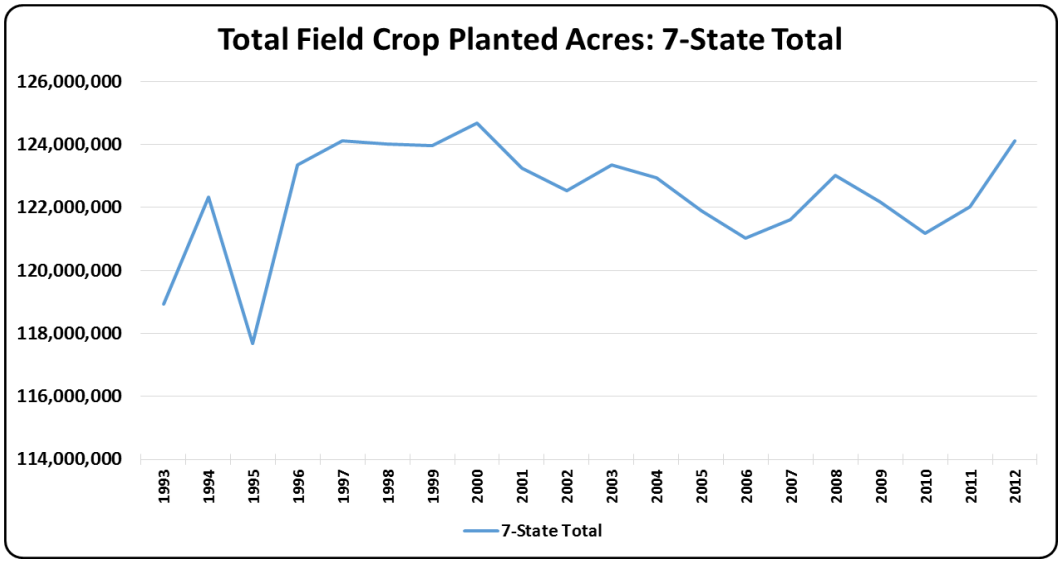


Figure 5, Total Field Crop Planted Acres: 7-State Total

Conservation Reserve Program

Since the CRP program first reached a degree of stability in 1990, acreage in the 7-state study area has fluctuated between a high of 8.8 million acres to a low of 6.4 million acres. For 2012 the 7-state study area total CRP acreage was approximately 6.8 million acres. Acres enrolled in the CRP program in 2012 represent 5.5 percent of total farmland in principal crops in the 7-state study area. Current acreage enrollment trends suggest that CRP acres in the 7-state study area will continue to decline as they have done since 2008. Historical total CRP enrollment is shown in Figure 6.

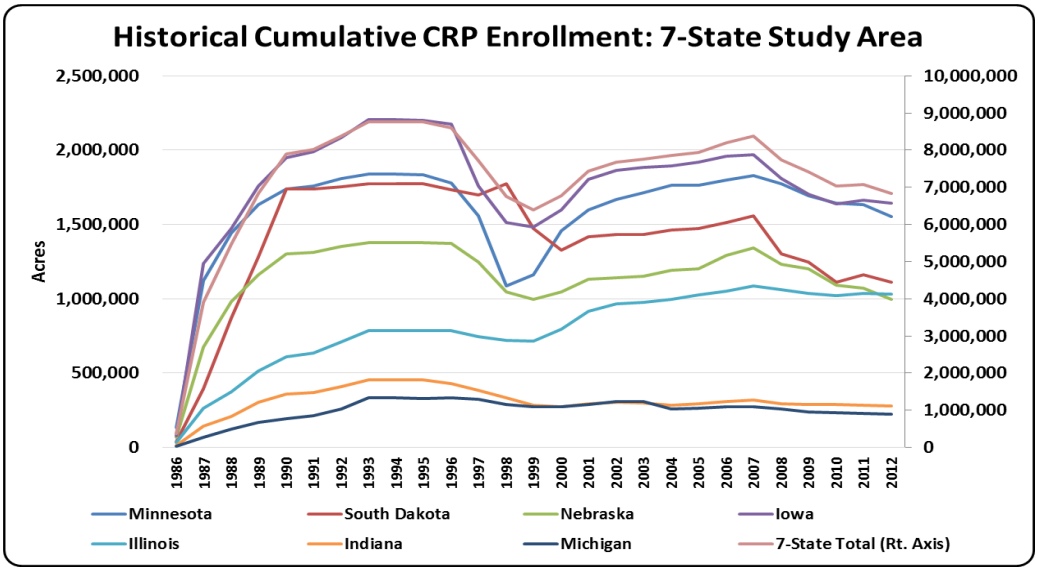


Figure 6, Historical Cumulative CRP Enrollment: 7-State Study Area

Spatial Results

Given some of the challenges addressed earlier pertaining to relying solely upon CDL data, all spatial results discussed in this section are what would be considered the most accurate interpretation of such data. We acknowledge that there are still issues with the data (overstatement of grassland), but we believe this impact has been minimized due to our revised method for aggregation. As such, the spatial analysis for the 7-state study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012 (see Figure 7). Recall that in order to account for land use changes for both to and from the Grassy Habitat land use category, all land use changes are expressed on a net basis. Consequently, negative numbers can and do appear in both tables and charts associated with the data. A negative number is interpreted as a net movement *to* Grassy Habitat. Many states actually had a net movement to Grassy Habitat for several land use categories (Michigan, Indiana, Illinois, Iowa, and Minnesota).

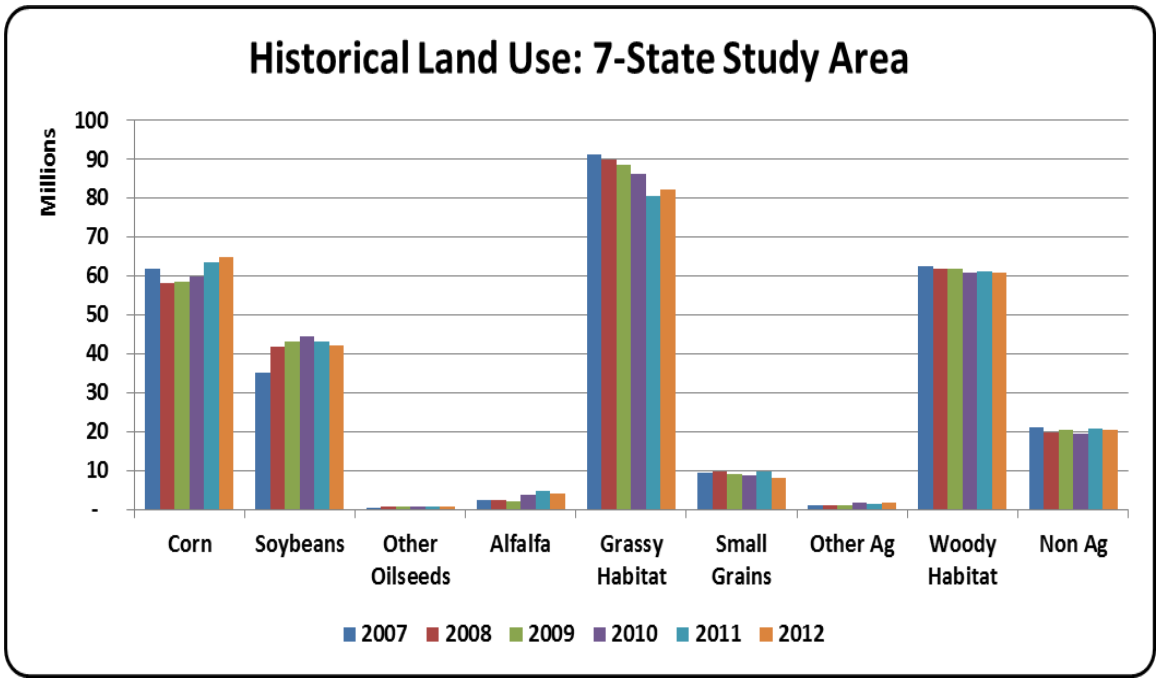


Figure 7, Historical Land Use: 7-State Study Area

Also of interest are the 7-state net land use changes for each of the eight possible outcomes. These totals are denoted by red diamonds in Figure 8. Table 5 shows, in descending order of degree to which land use changes occurred by land use change type, a summary of our estimates for the study area as a whole. Table 6 shows these same estimates by state. As shown in Tables 5 and 6, the total net change across the entire 7-state study area was 8.534 million acres. This represents 3.0 percent of total land in the 7-state study area. The majority of this net change was toward Corn (3.605 million), Soybeans

(2.175 million), Small Alfalfa (1.278 million), and Small Grains (1.254 million). Figure 5 shows annual totals for each land use category for the 7-state study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): 7-States	Net Change
Grassy Habitat to Corn	3,604,683
Grassy Habitat to Soybeans	2,174,547
Grassy Habitat to Alfalfa	1,277,765
Grassy Habitat to Small Grains	1,253,530
Grassy Habitat to Other Ag	156,421
Grassy Habitat to Other Oilseeds	139,503
Grassy Habitat to Woody Habitat	112,500
Grassy Habitat to Non Ag	(185,339)
Net Change FROM Grassy Habitat	8,533,610

Table 5, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): 7-State Study Area

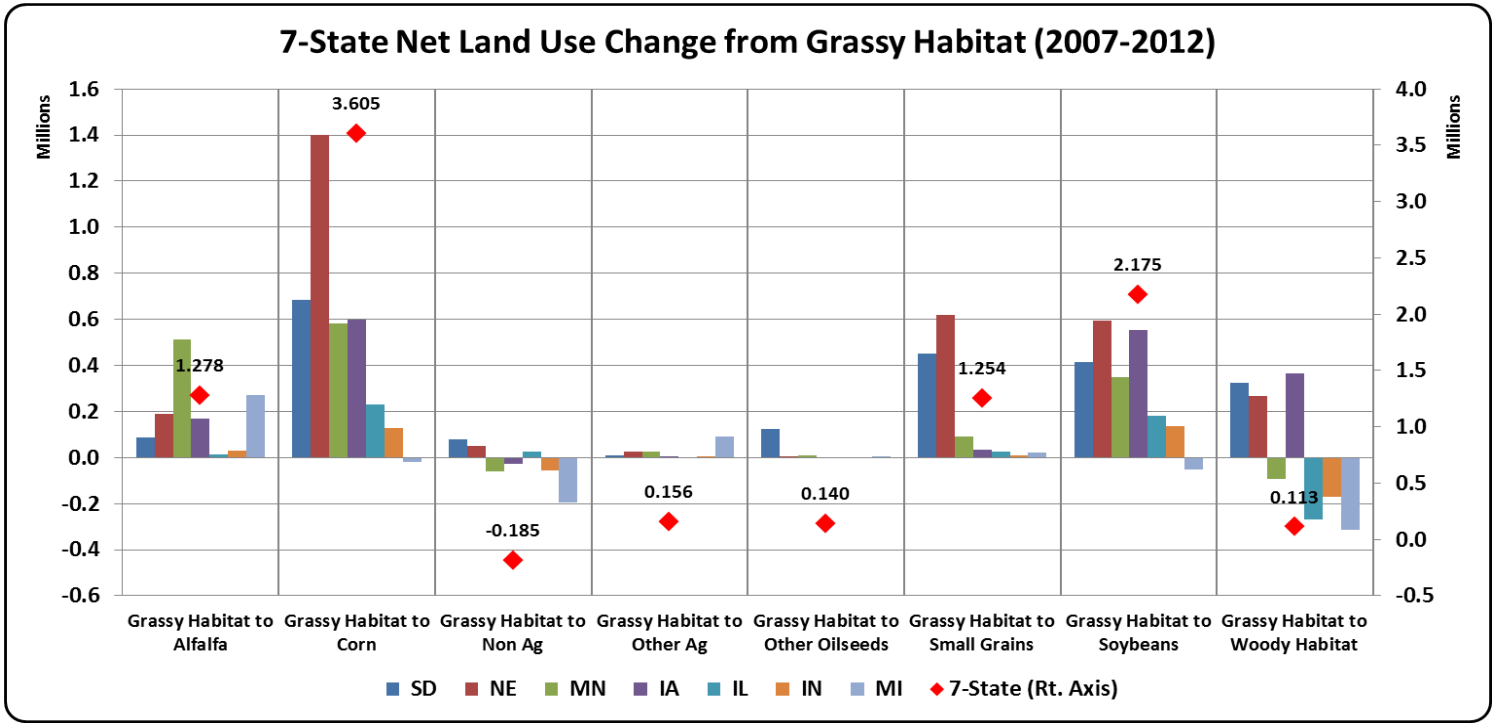


Figure 8, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): 7-State Study Area

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	SD	NE	MN	IA	IL	IN	MI	7-State
Grassy Habitat to Alfalfa	86,611	191,155	511,791	170,640	15,266	30,834	271,467	1,277,765
Grassy Habitat to Corn	682,573	1,400,212	582,108	598,692	230,435	127,991	(17,328)	3,604,683
Grassy Habitat to Non Ag	78,200	49,625	(61,389)	(26,500)	25,714	(56,231)	(194,757)	(185,339)
Grassy Habitat to Other Ag	8,911	27,043	26,211	1,061	(640)	808	93,026	156,421
Grassy Habitat to Other Oilseeds	125,135	5,422	8,606	(10)	(1)	-	350	139,503
Grassy Habitat to Small Grains	451,626	617,025	93,175	33,364	23,758	10,950	23,631	1,253,530
Grassy Habitat to Soybeans	414,804	594,305	347,651	553,597	179,657	136,234	(51,702)	2,174,547
Grassy Habitat to Woody Habitat	324,159	265,887	(91,519)	366,385	(267,445)	(170,574)	(314,393)	112,500
Net Change FROM Grassy Habitat	2,172,019	3,150,675	1,416,635	1,697,229	206,744	80,013	(189,706)	8,533,610

Table 6, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): 7-State Study Area

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed “program crops”. This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figure 9 and Table 7. On a net basis, an estimated total of 7.033 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains, the bulk of which is in the western portion of the study area. The movement of 7.033 million acres to program crops represents 5.7 percent of total land in principal field crops in the 7-state study area.

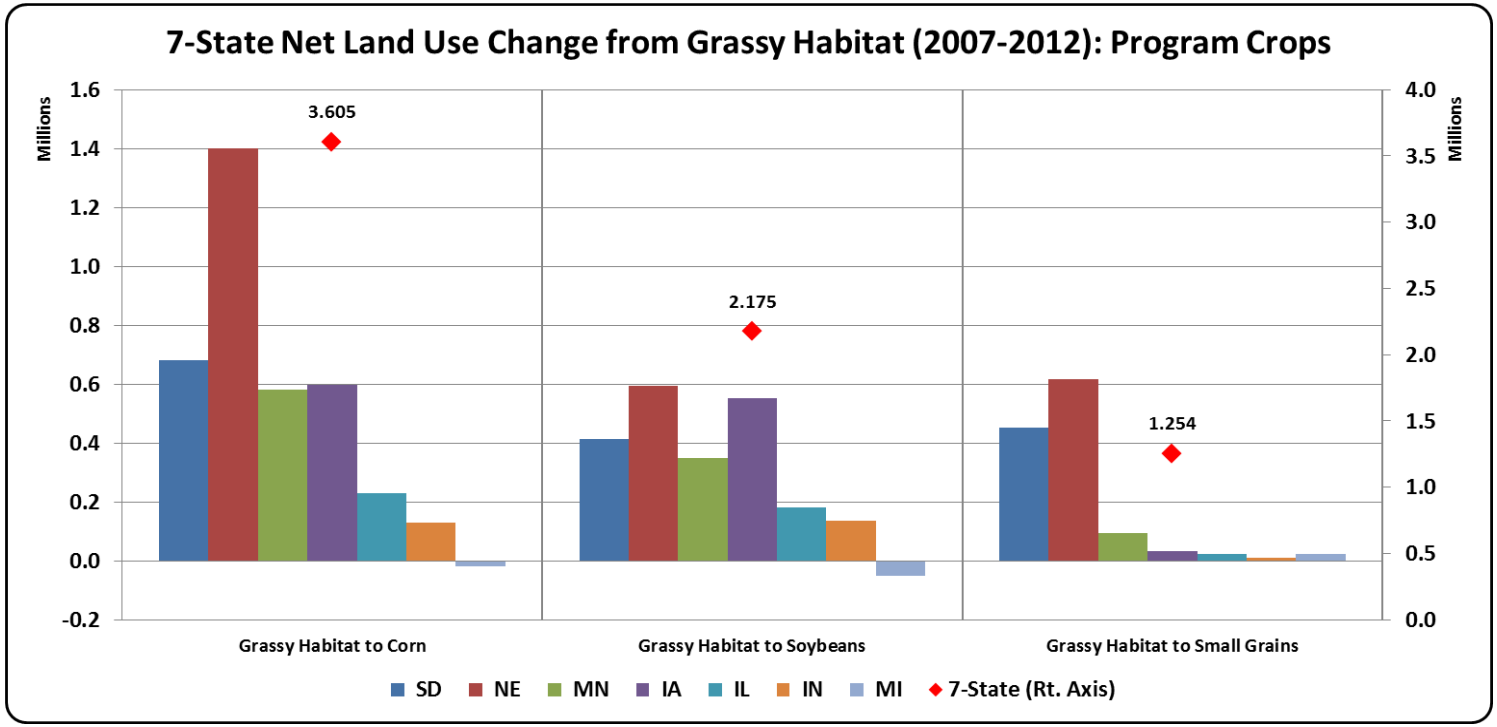


Figure 9, 2007-2012 Net Change (Grassy Habitat to Program Crops): 7-State Study Area

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	SD	NE	MN	IA	IL	IN	MI	7-State
Grassy Habitat to Corn	682,573	1,400,212	582,108	598,692	230,435	127,991	(17,328)	3,604,683
Grassy Habitat to Soybeans	414,804	594,305	347,651	553,597	179,657	136,234	(51,702)	2,174,547
Grassy Habitat to Small Grains	451,626	617,025	93,175	33,364	23,758	10,950	23,631	1,253,530
Net Change FROM Grassy Habitat	1,549,003	2,611,542	1,022,934	1,185,653	433,850	275,175	(45,398)	7,032,760

Table 7, 2007-2012 Net Change (Grassy Habitat to Program Crops): 7-State Study Area

SOUTH DAKOTA

Background

In terms of a historical perspective on land use in South Dakota, acreage in farms has ranged from a low of 14.3 million acres in 1995 to a high of 17.7 million acres in 2001. Estimated acreage devoted to principal field crops (corn, soybeans, wheat, sunflower, and hay) in 2012 (17.5 million) is the fourth highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 36.1 percent of land acres in South Dakota. Referring to Figure 10, three of the top five years of acres being devoted to the planting of field crops have occurred since 2008.

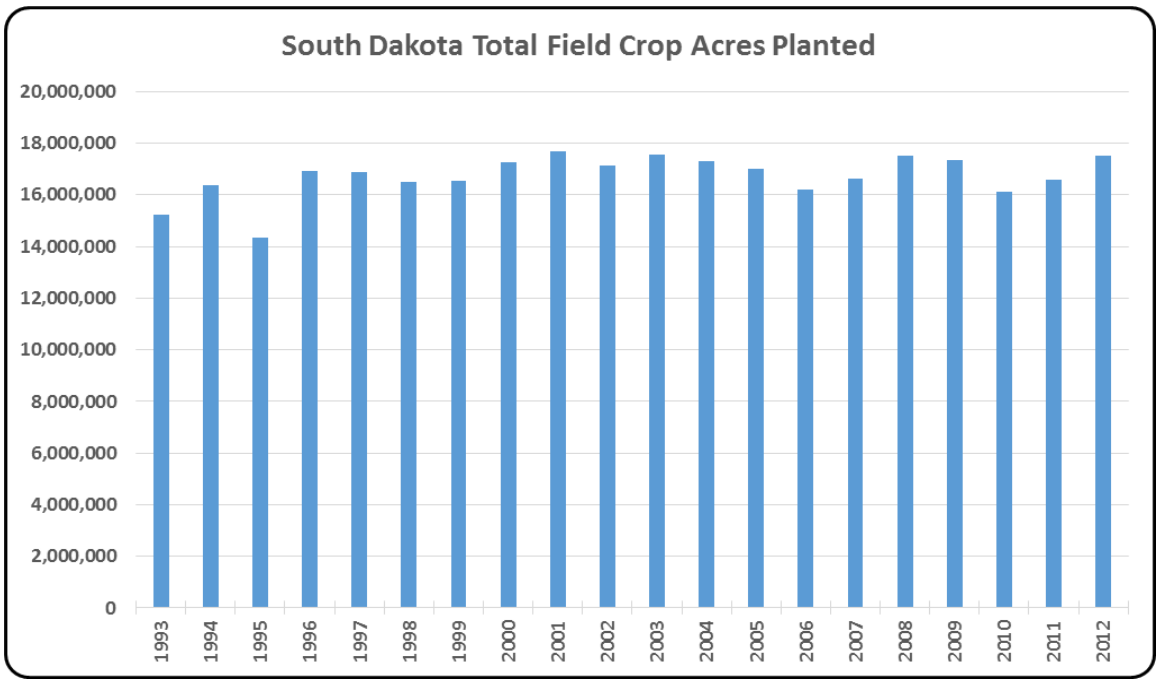


Figure 10, South Dakota Total Field Crop Planted Acres

Referring to Figure 11, South Dakota saw very few acres enrolled in the CRP program when it was implemented, but quickly reached 1.8 million by 1990. It held steady for the next eight years, until the first round of 10-year contracts began to expire. Since 2000, there were slight increases until 2007, but the total never exceeded 1.6 million acres. Since 2007, the number of acres enrolled in South Dakota has dropped off and is now near 1.1 million acres. South Dakota acres enrolled in the CRP program in 2012 represent 6.3 percent of total farmland in principal crops in the state.

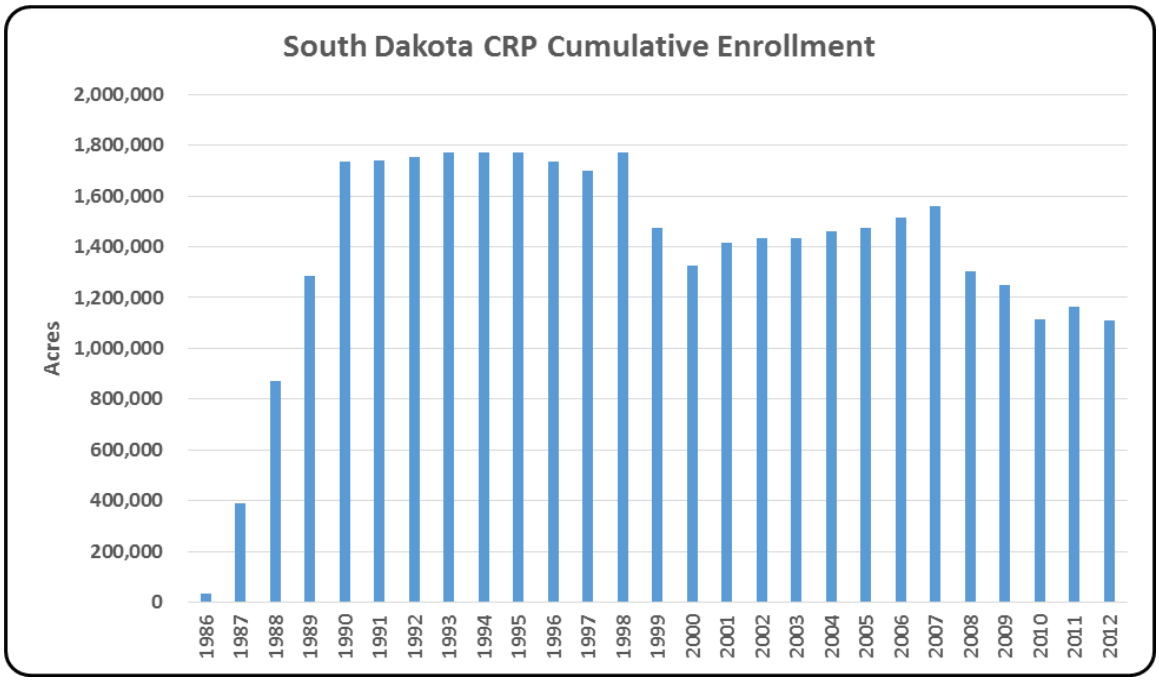


Figure 11, South Dakota CRP Cumulative Enrollment

Spatial Results

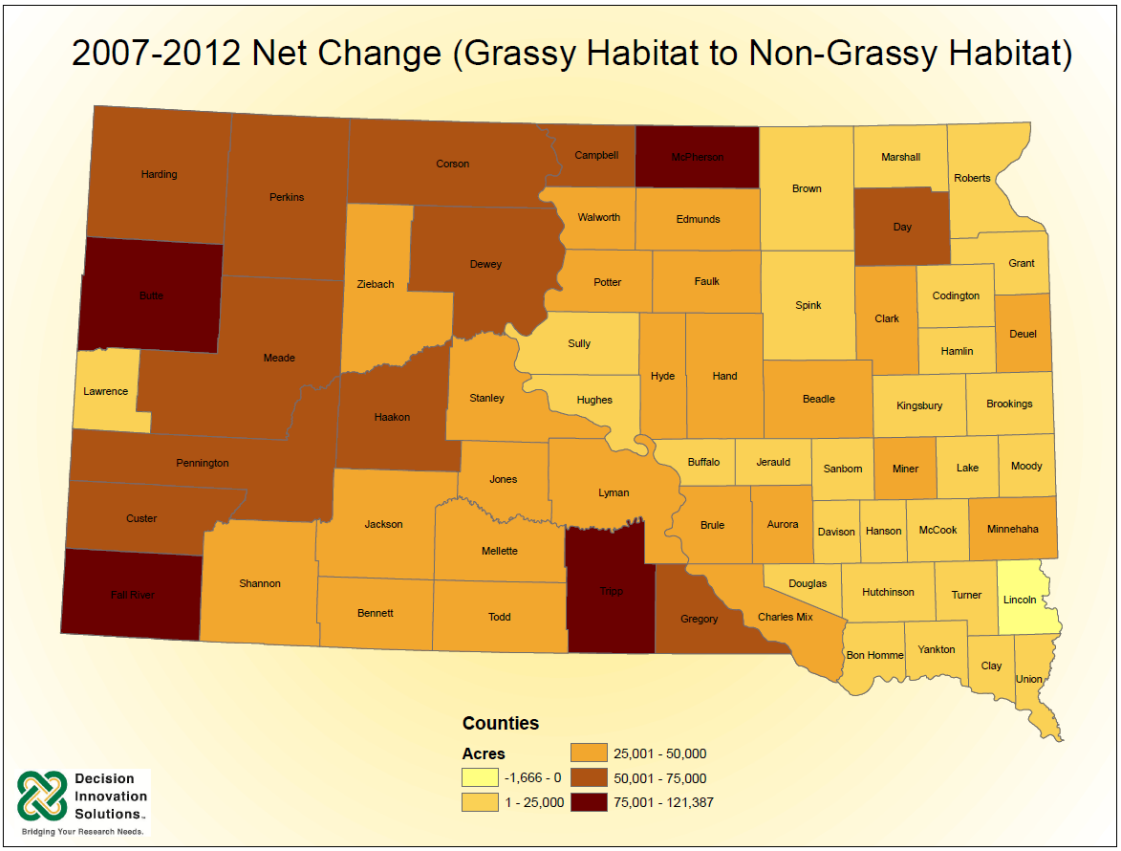


Figure 12, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): South Dakota Counties

Referring to Figures 12-13 and Table 8, the spatial analysis for the South Dakota study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. In South Dakota, there was a positive net land use change from the Grassy Habitat land use category to other categories. The majority of this net land use change from Grassy Habitat was toward Corn, Small Grains, Soybeans, and Woody Habitat.

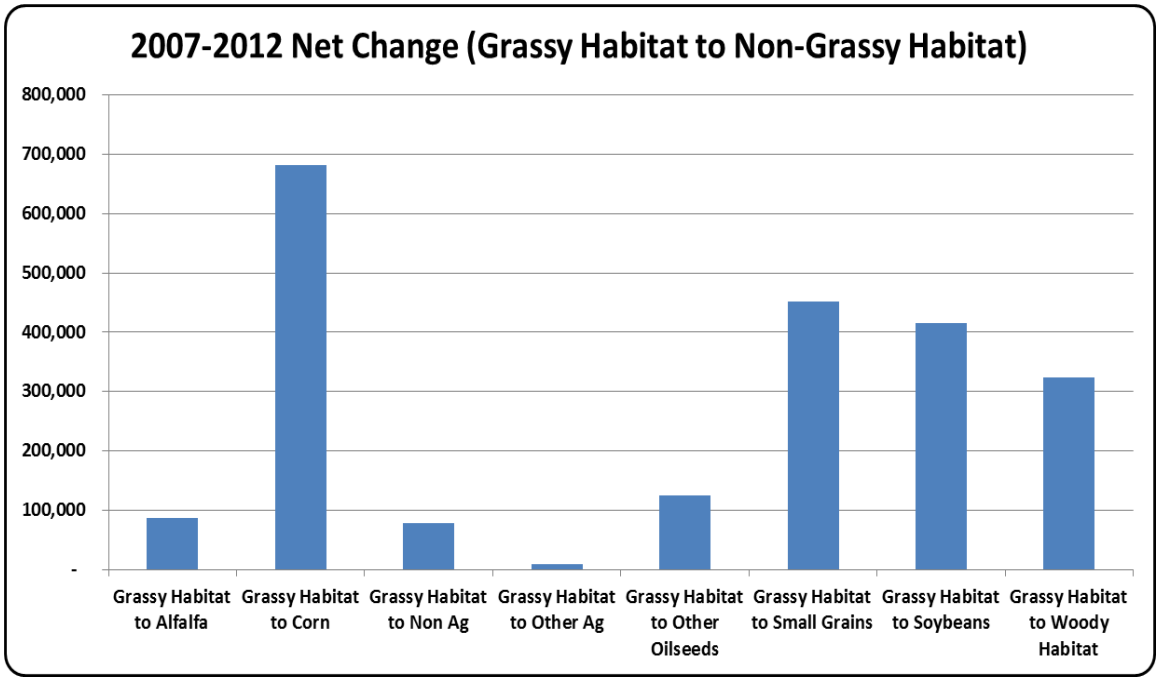


Figure 13, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): South Dakota

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	86,611
Grassy Habitat to Corn	682,573
Grassy Habitat to Non Ag	78,200
Grassy Habitat to Other Ag	8,911
Grassy Habitat to Other Oilseeds	125,135
Grassy Habitat to Small Grains	451,626
Grassy Habitat to Soybeans	414,804
Grassy Habitat to Woody Habitat	324,159
Net Change FROM Grassy Habitat	2,172,019

Table 8, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): South Dakota

Table 9 shows, in descending order of degree to which changes occurred by land use type, a summary of our estimates for net land use change in South Dakota from 2007-2012. As shown in Table 9, the total net change (decrease) in Habitat acreage across the South Dakota study area was 2.172 million acres.

This represents 4.4 percent of total land in South Dakota. The majority of this net land use change from Grassy Habitat was toward Corn (0.683 million acres), followed by Small Grains (0.452 million acres), Soybeans (0.415 million acres), and Woody Habitat (0.324 million acres). Figure 14 shows annual totals for each land use category for the South Dakota study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Corn	682,573
Grassy Habitat to Small Grains	451,626
Grassy Habitat to Soybeans	414,804
Grassy Habitat to Woody Habitat	324,159
Grassy Habitat to Other Oilseeds	125,135
Grassy Habitat to Alfalfa	86,611
Grassy Habitat to Non Ag	78,200
Grassy Habitat to Other Ag	8,911
Net Change FROM Grassy Habitat	2,172,019

Table 9, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): South Dakota

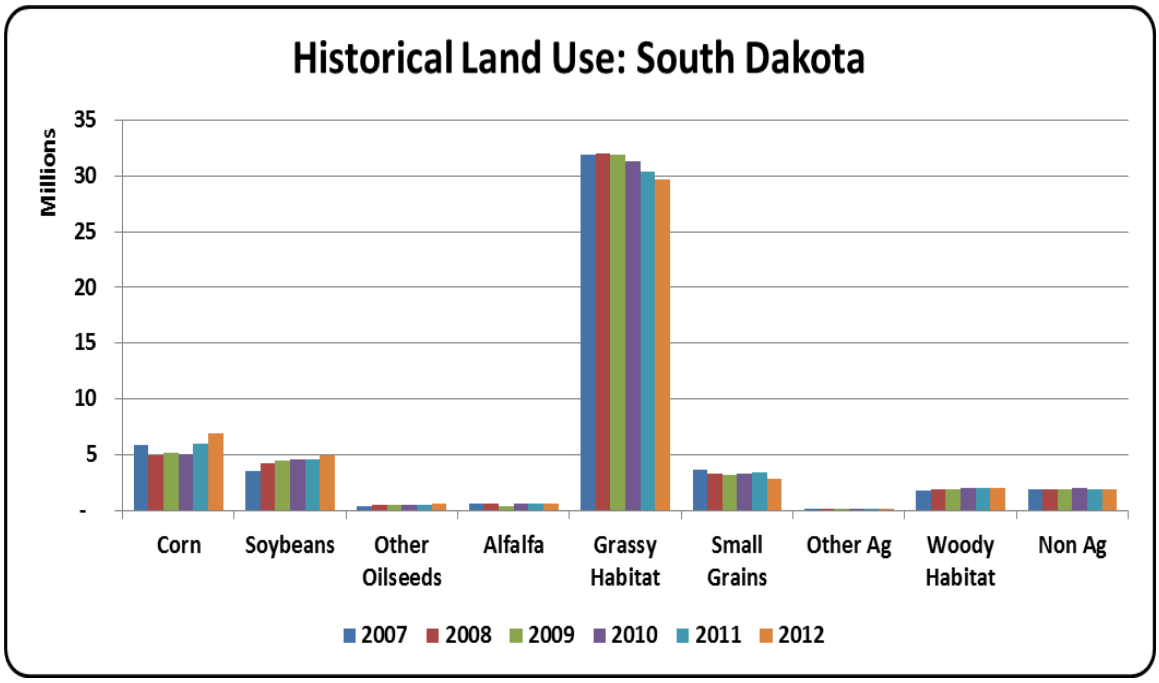


Figure 14, Historical Land Use: South Dakota

Observations

Because of the relatively low acreage of Other Oilseeds and Other Ag within South Dakota, we did not anticipate much of a shift from Grassy Habitat to these land use categories. Due to South Dakota's geography and recent increases in land devoted to crops, shifts toward Corn, Soybeans, Small Grains, and Alfalfa was expected, but the degree to which movement to crops was less than anticipated. Upon

further inspection of the spatial data, it appears that much of the land use conversion from Grassy Habitat toward crops has occurred primarily along major rivers or where irrigation is more prevalent.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed "program crops". This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 15-16 and Table 10. On a net basis, an estimated total of 1.549 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains. This represents 3.1 percent of total land in principal field crops in South Dakota. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the South Dakota Results section.

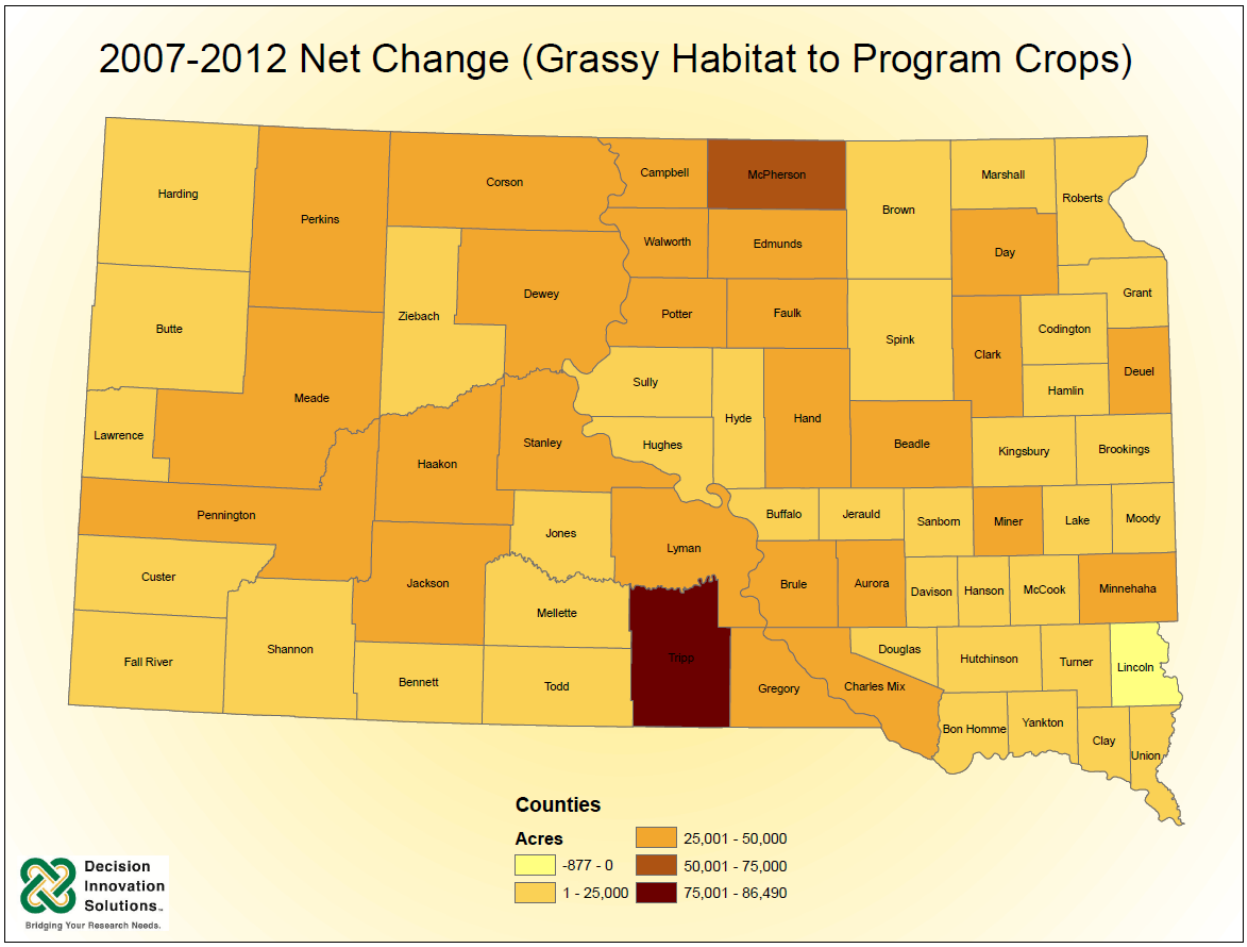


Figure 15, 2007-2012 Net Change (Grassy Habitat to Program Crops): South Dakota Counties

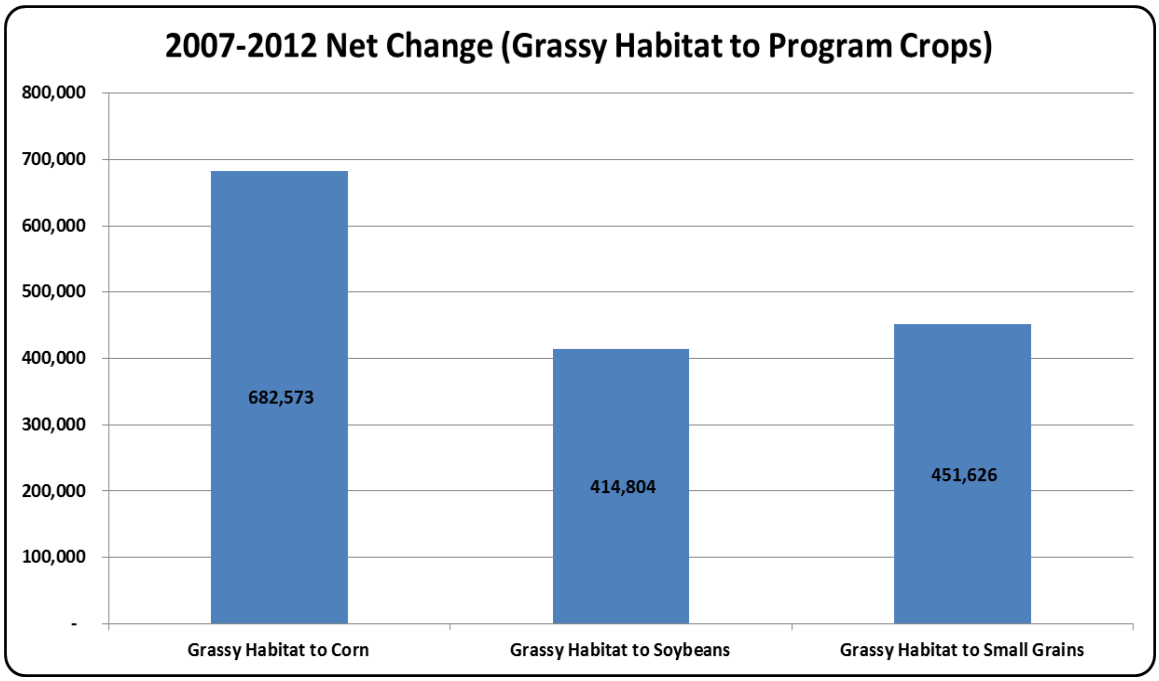


Figure 16, 2007-2012 Net Change (Grassy Habitat to Program Crops): South Dakota

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	682,573
Grassy Habitat to Soybeans	414,804
Grassy Habitat to Small Grains	451,626
Total Net Change to Program Crops	1,549,003

Table 10, 2007-2012 Net Change (Grassy Habitat to Program Crops): South Dakota

Econometric Results

Table 11 provides econometric results for South Dakota. A summary of econometric results with regard to the explanatory variables for South Dakota is provided below.

- **Crop Insurance Subsidies**
  - Variable is significant at the 95% level and exhibits the expected sign (-).
    - Result suggests that the higher the Crop Insurance Subsidy, the lower the share of land devoted to Grassy Habitat.
- **Net Returns**
  - Variable is insignificant at the 95% level, but exhibits the expected sign (-).
    - Due to insignificance, no explanatory power is gleaned from the Net Returns variable with regards to its impact on the share of land devoted to Grassy Habitat.

- **Growing Degree Days**
    - Variable is significant at the 95% level and exhibits the expected sign (-).
        - Result suggests that the higher the Growing Degree Days, the lower the share of land devoted to Grassy Habitat.
- **Precipitation**
    - Variable is significant at the 95% level and exhibits the expected sign (-).
        - Result suggests that the higher the Precipitation, the lower the share of land devoted to Grassy Habitat.

Table 11, Econometric Results: South Dakota

OLS Regression Statistics for GrassHab Ratio, 6/20/2013 6:04:59 PM					
F-test	58.035	**Prob(F)**	0.000	**Unrestricted Model**	
MSE1/2	0.200	**CV Regr**	37.699	**F-test**	58.035
R2	0.373	**Durbin-Watson**	1.754	**R2**	0.373
RBar2	0.366	**Rho**	0.121	**RBar2**	0.366
Akaike Information Criterion	-3.214	**Goldfeld-Quandt**	0.969	**Akaike Information Cr**	-3.214
Schwarz Information Criterion	-3.174			**Schwarz Information C**	-3.174
95%	**Intercept**	**CIS**	**RET**	**GDD**	**Precip**
Beta	**1.680**	**-0.010**	0.000	**-0.300**	**-0.557**
S.E.	0.101	0.001	0.000	0.077	0.043
t-test	16.555	-7.692	-0.480	-3.887	-12.821
Prob(t)	0.000	0.000	0.632	0.000	0.000
Elasticity at Mean		-0.533	-0.020	-0.567	-1.051
Variance Inflation Factor		1.056	1.142	1.036	1.131
Partial Correlation		-0.363	-0.024	-0.193	-0.544
Semipartial Correlation		-0.308136619	-0.019220873	-0.155718961	-0.51362005
Restriction					

The model results for South Dakota illustrate the impact of the state's landscape on the propensity for ground to support crop production. As described, the results for both Growing Degree Days and Precipitation were significant and exhibited the expected sign. As both Growing Degree Days and Precipitation increase from west to east, the share of land devoted to Grassy Habitat declines. Because expectations were that Net Returns would have an impact on the share of land devoted to Grassy Habitat, the insignificant results for this variable were surprising.

NEBRASKA

Background

In terms of a historical perspective on the land use in Nebraska, acreage in farms for the area has ranged from a low of 18.3 million acres in 1995 to a high of 19.6 million acres in 2012. Estimated acreage devoted to principal field crops (corn, soybeans, wheat, hay, and sorghum) in 2012 is the highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 39.7 percent of land acres in Nebraska. Referring to Figure 17, after having fairly consistent declines in acreage devoted to field crops since 1999, the trend reversed in 2007 and has climbed steadily higher since.

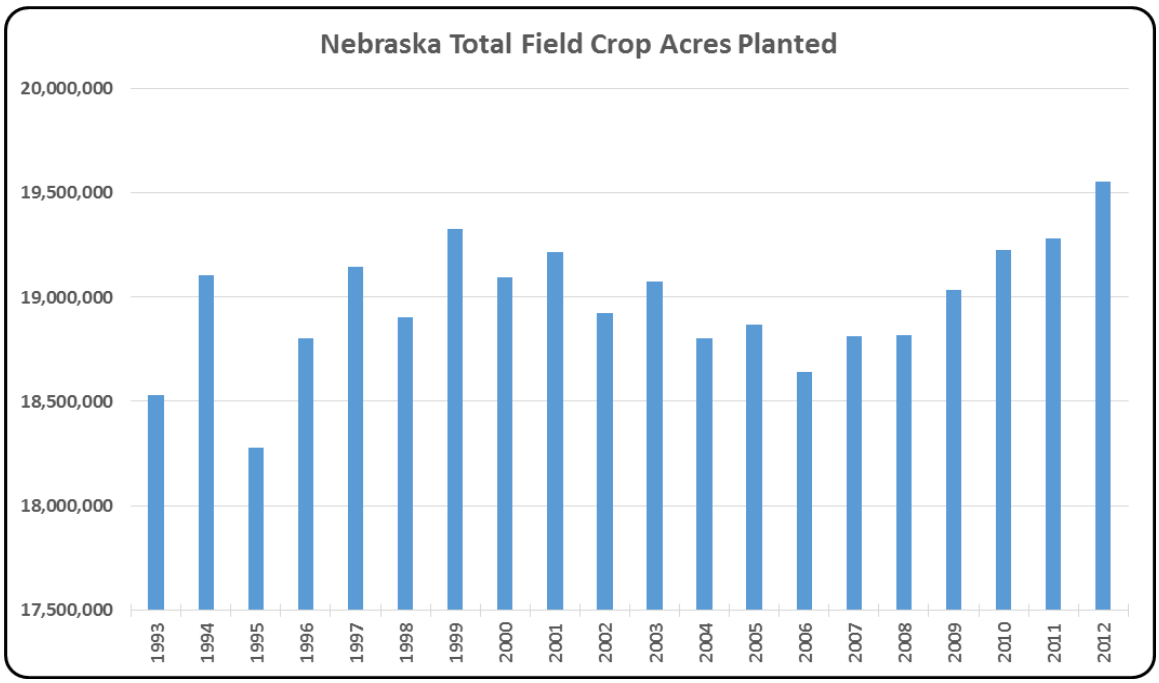


Figure 17, Nebraska Total Field Crop Planted Acres

Referring to Figure 18, by 1990 Nebraska reached 1.3 million acres enrolled in the CRP program and held fairly steady until the first round of 10-year contracts starting expiring. Since then, the acres enrolled in the program grew slightly until 2007, but has since seen the effects of higher prices crop prices and the need for usable farmland. Nebraska acres enrolled in the CRP program in 2012 represent 5.1 percent of total farmland in principal crops in the state.

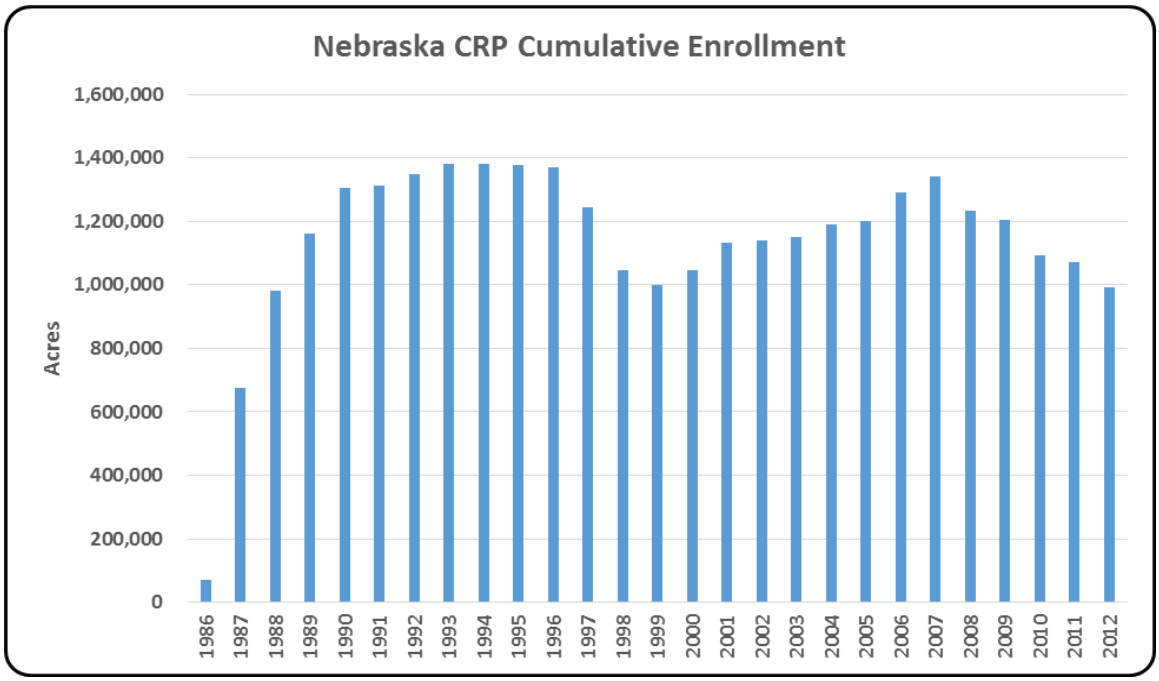


Figure 18, Nebraska CRP Cumulative Enrollment

Spatial Results

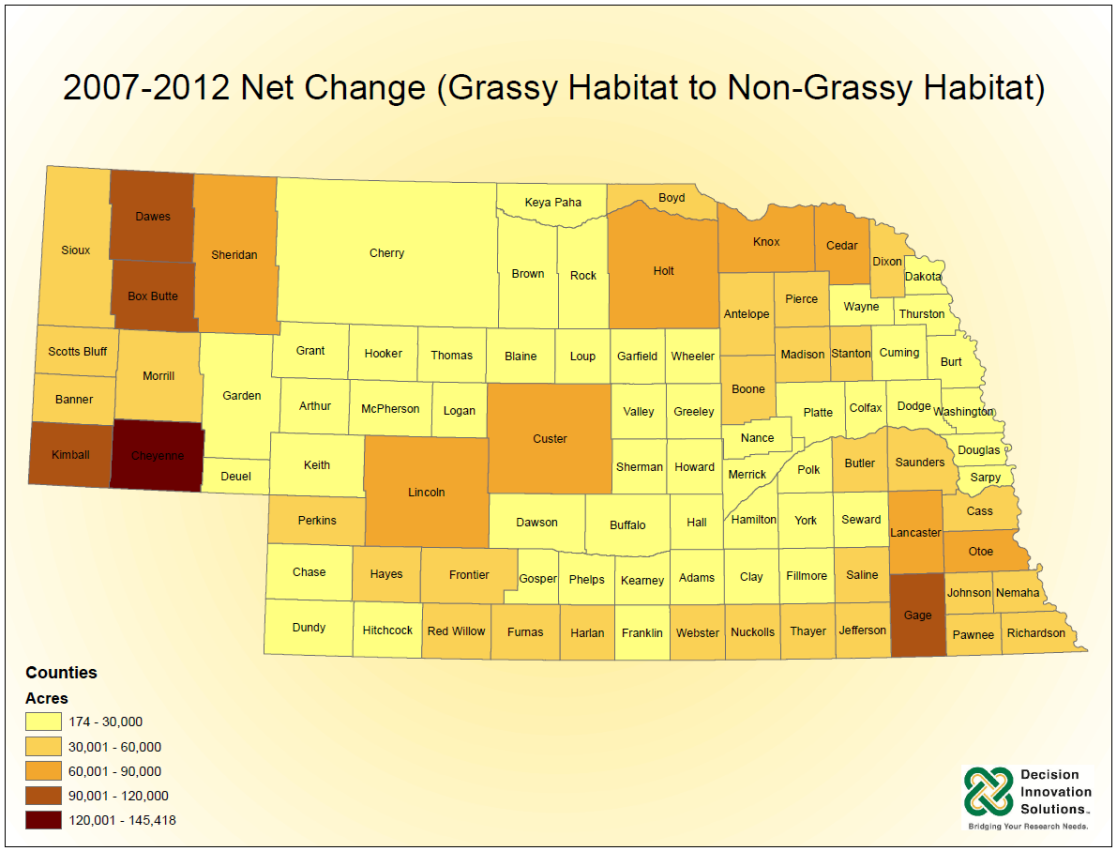


Figure 19, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Nebraska Counties

Referring to Figures 19-20 and Table 12, the spatial analysis for the Nebraska study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. In Nebraska, there was a positive net land use change from the Grassy Habitat land use category to other categories. The majority of this net land use change from Grassy Habitat was toward Corn, Small Grains, Soybeans, and Woody Habitat.

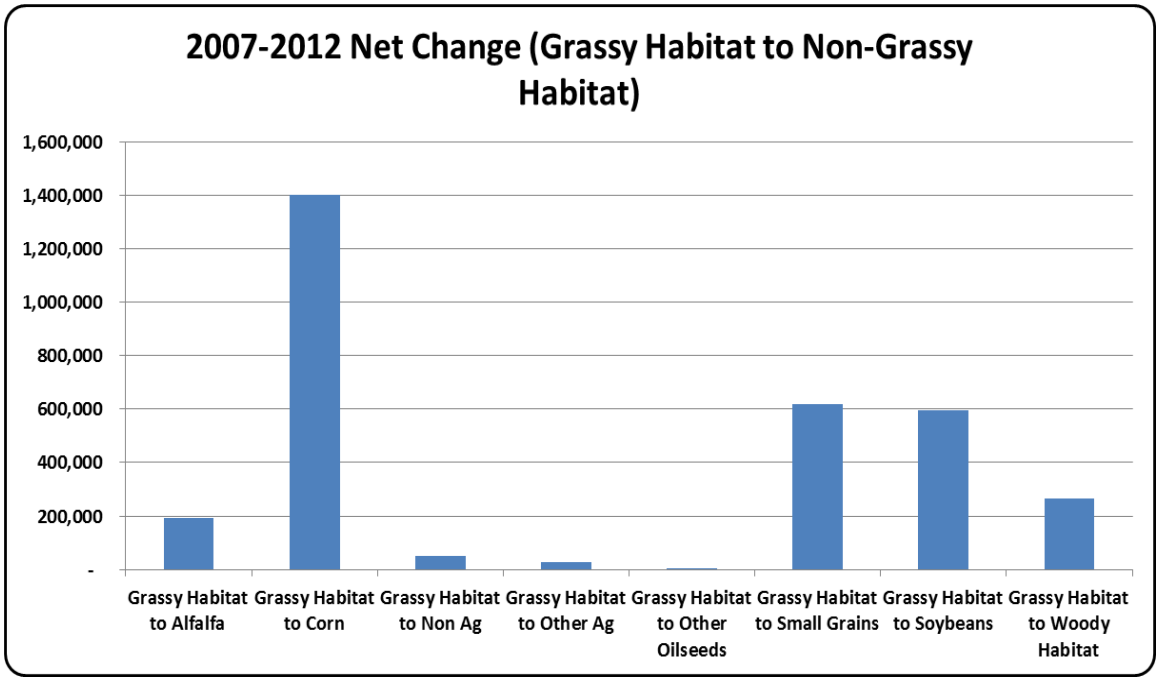


Figure 20, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Nebraska

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	191,155
Grassy Habitat to Corn	1,400,212
Grassy Habitat to Non Ag	49,625
Grassy Habitat to Other Ag	27,043
Grassy Habitat to Other Oilseeds	5,422
Grassy Habitat to Small Grains	617,025
Grassy Habitat to Soybeans	594,305
Grassy Habitat to Woody Habitat	265,887
Net Change FROM Grassy Habitat	3,150,675

Table 12, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Nebraska

Table 13 shows, in descending order of degree to which changes occurred by land use type, a summary of our estimates for net land use change in Nebraska from 2007-2012. As shown in Table 13, the total net change (decrease) in Habitat acreage across the Nebraska study area was 3.151 million acres. This

represents 6.4 percent of total land in the Nebraska. The majority of this net land use change from Grassy Habitat was toward Corn (1.400 million acres), followed by Small Grains (0.617 million acres), Soybeans (0.594 million acres), and Woody Habitat (0.266 million acres). Figure 21 shows annual totals for each land use category for the Nebraska study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Corn	1,400,212
Grassy Habitat to Small Grains	617,025
Grassy Habitat to Soybeans	594,305
Grassy Habitat to Woody Habitat	265,887
Grassy Habitat to Alfalfa	191,155
Grassy Habitat to Non Ag	49,625
Grassy Habitat to Other Ag	27,043
Grassy Habitat to Other Oilseeds	5,422
Net Change FROM Grassy Habitat	3,150,675

Table 13, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): Nebraska

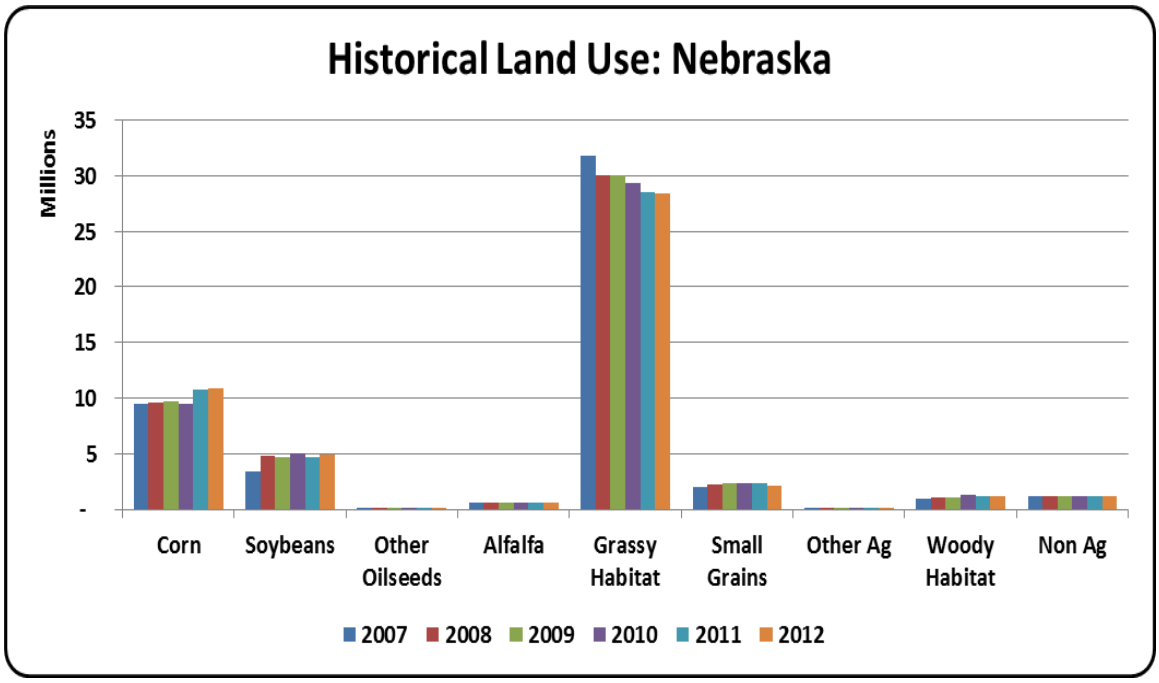


Figure 21, Historical Land Use: Nebraska

Observations

Due to the relatively low acreage of Other Oilseeds and Other Ag within Nebraska, we did not anticipate much of a shift from Grassy Habitat to these land use categories. As suspected, our estimates suggest that there were shifts of Grassy Habitat acreage toward Corn, Soybeans, Small Grains, and Alfalfa. Net land use changes in Nebraska from Habitat to Corn, Soybeans, Small Grains, and Alfalfa were larger

when compared to other states in the 7-state study area. Upon further inspection of the data (see Figure 22), it appears that much of this land use conversion from Habitat toward Corn, Soybeans, Small Grains, and Alfalfa has occurred in the western, southeastern, and northeastern portions of the state.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed "program crops". This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 22-23 and Table 14. On a net basis, an estimated total of 2.612 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains. This represents 5.3 percent of total land in principal field crops in in Nebraska. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the Nebraska Results section.

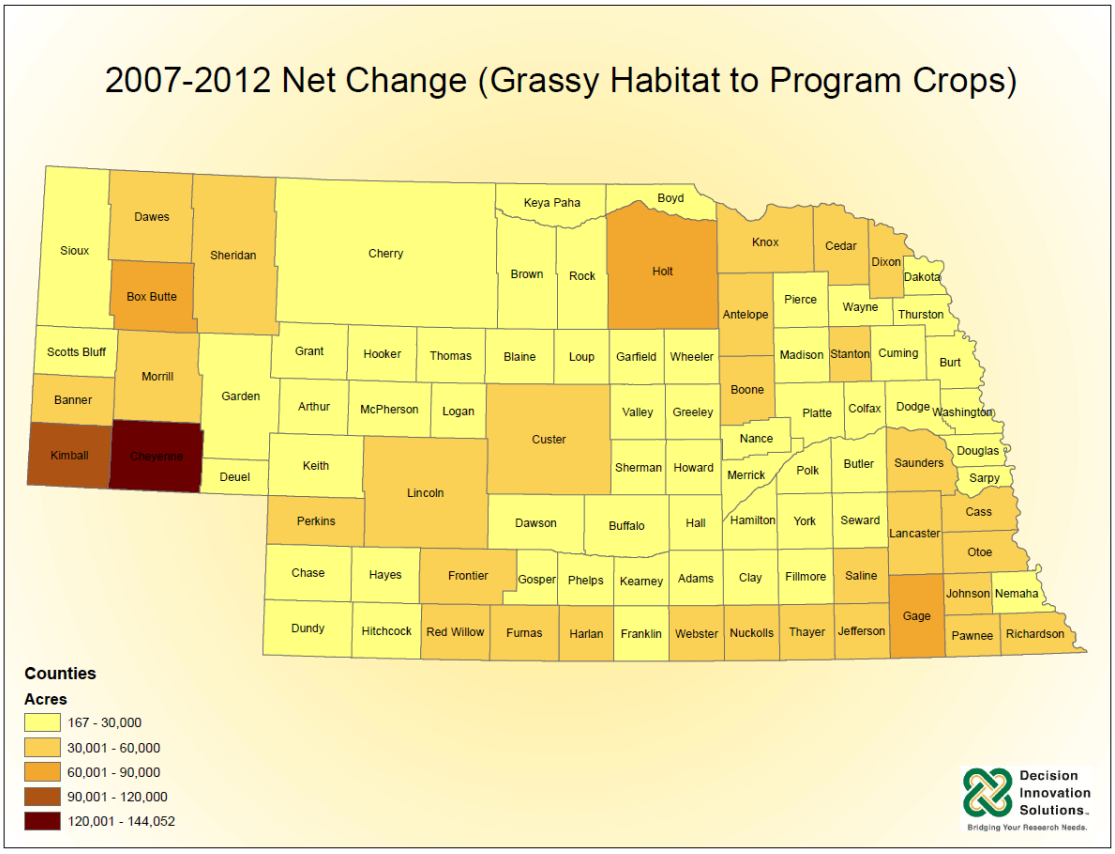


Figure 22, 2007-2012 Net Change (Grassy Habitat to Program Crops): Nebraska Counties

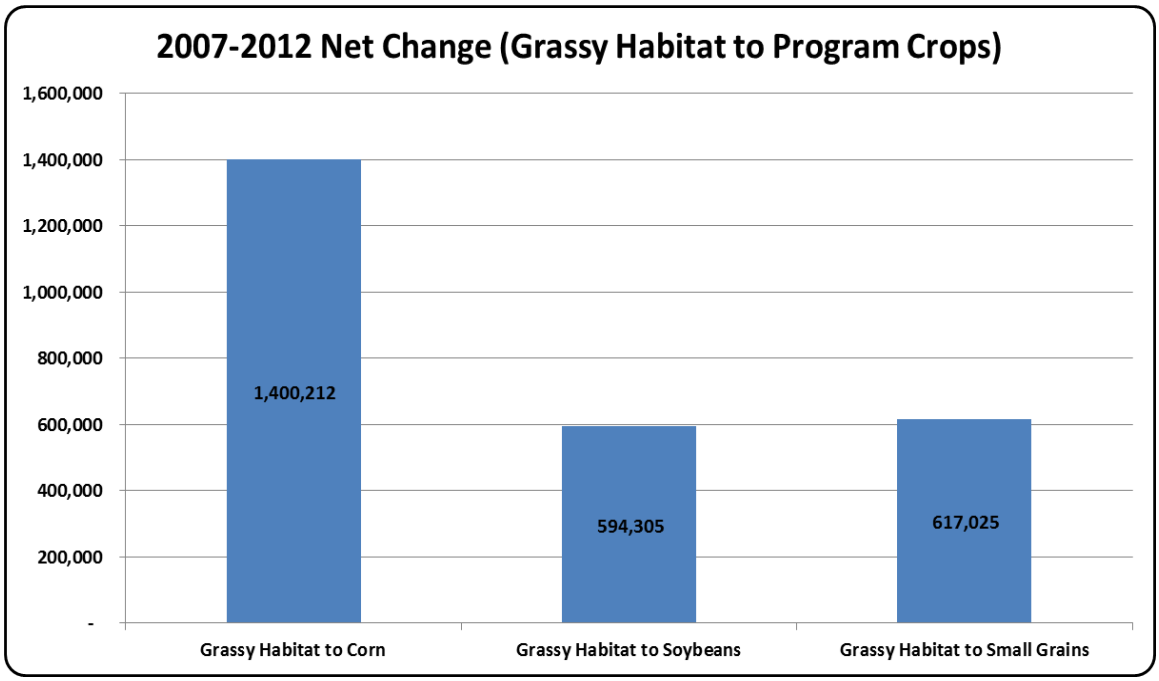


Figure 23, 2007-2012 Net Change (Grassy Habitat to Program Crops): Nebraska

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	1,400,212
Grassy Habitat to Soybeans	594,305
Grassy Habitat to Small Grains	617,025
Total Net Change to Program Crops	2,611,542

Table 14, 2007-2012 Net Change (Grassy Habitat to Program Crops): Nebraska

Econometric Results

Table 15 provides results for Nebraska. A summary of econometric results with regard to the explanatory variables for Nebraska is provided below.

- **Crop Insurance Subsidies**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Crop Insurance Subsidy, the higher the share of land devoted to Grassy Habitat.
- **Net Returns**
  - Variable is insignificant at the 95% level and *does not* exhibit the expected sign (-).
    - Due to insignificance, no explanatory power is gleaned from the Net Returns variable with regards to its impact on the share of land devoted to Grassy Habitat.

- **Growing Degree Days**
    - Variable is significant at the 95% level and exhibits the expected sign (-).
        - Result suggests that the higher the Growing Degree Days, the lower the share of land devoted to Grassy Habitat.
- **Precipitation**
    - Variable is significant at the 95% level and exhibits the expected sign (-).
        - Result suggests that the higher the Precipitation, the lower the share of land devoted to Grassy Habitat.

Table 15, Econometric Results: Nebraska

OLS Regression Statistics for GrassHab Ratio, 6/20/2013 6:23:11 PM					
F-test	74.437	**Prob(F)**	0.000	**Unrestricted Model**	
MSE1/2	0.234	**CV Regr**	47.732	**F-test**	74.437
R2	0.350	**Durbin-Watson**	1.110	**R2**	0.350
RBar2	0.345	**Rho**	0.445	**RBar2**	0.345
Akaike Information Criterion	-2.899	**Goldfeld-Quandt**	1.265	**Akaike Information Cr**	-2.899
Schwarz Information Criterion	-2.868			**Schwarz Information C**	-2.868

95%	Intercept	CIS	RET	GDD	Precip
Beta	**1.256**	**0.011**	0.000	**-0.771**	**-0.290**
S.E.	0.115	0.001	0.000	0.098	0.035
t-test	10.914	7.425	0.517	-7.904	-8.255
Prob(t)	0.000	0.000	0.605	0.000	0.000
Elasticity at Mean		0.578	0.024	-1.573	-0.592
Variance Inflation Factor		1.183	1.355	1.313	1.125
Partial Correlation		0.301	0.022	-0.319	-0.331
Semipartial Correlation		0.254578103	0.017719994	-0.270980786	-0.28301372
Restriction					

The model results for Nebraska illustrate the impact the state's landscape has on the propensity for ground to support crop production. As described, the results for both Growing Degree Days and Precipitation were significant and exhibited the expected sign. As both Growing Degree Days and Precipitation increase from west to east, the share of land devoted to Grassy Habitat declines. This result is similar to those gleaned from South Dakota, which seems logical since both states have similarities from west to east. Insignificance for both Crop Insurance Subsidies and Net Returns was an unexpected result. Also, the presence of an unexpected sign for Crop Insurance Subsidies suggests there are other factors at work with regard to crop insurance subsidies' impact on land use decisions. Further, the "overstatement of grassland by CDL" issue explored earlier may also be confounding these results.

MINNESOTA

Background

In terms of a historical perspective on the land use in Minnesota, acreage in farms has ranged from a low of 19.3 million acres in 1993 to a high of 20.5 million acres in 1998. Estimated acreage devoted to principal field crops (corn, soybeans, wheat, oats, sunflowers, dry edible beans, hay, potatoes, sugar beets, flaxseed, and canola) in 2012 (20.0 million acres) is the eighth highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 37.4 percent of land acres in Minnesota. Referring to Figure 24, not since 2003 have more than 20 million acres been devoted to the planting of crops.

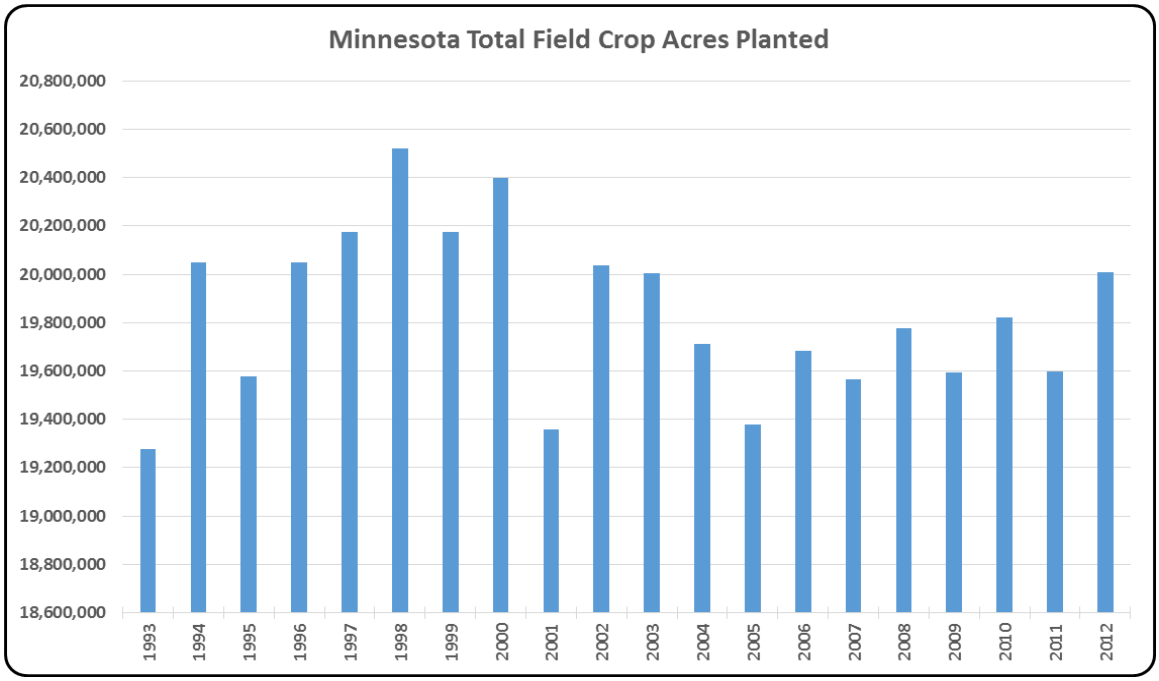


Figure 24, Minnesota Total Field Crop Planted Acres

Referring to Figure 25, when CRP was implemented in 1986, Minnesota enrolled 0.130 million acres in the program. The following year it increased more than one million acres and steadily increased until 1993 and 1994 when there was record enrollment of 1.837 million acres. In 1996 and 1997, Minnesota saw decreases in CRP acreage due to the expiration of all the 10-year contracts, some of which were not being renewed, or no longer eligible for renewal due to changes in CRP program criteria. During the next decade, cropland enrolled in the CRP program increased, reaching a new peak in 2008. Higher crop prices resulting in higher net returns for crop production have made CRP rental rates less competitive in recent years and have most likely been a reason for the decline in CRP-enrolled acreage since 2008.

Minnesota acres enrolled in the CRP program in 2012 represent 7.8 percent of total farmland in principal crops in the state.

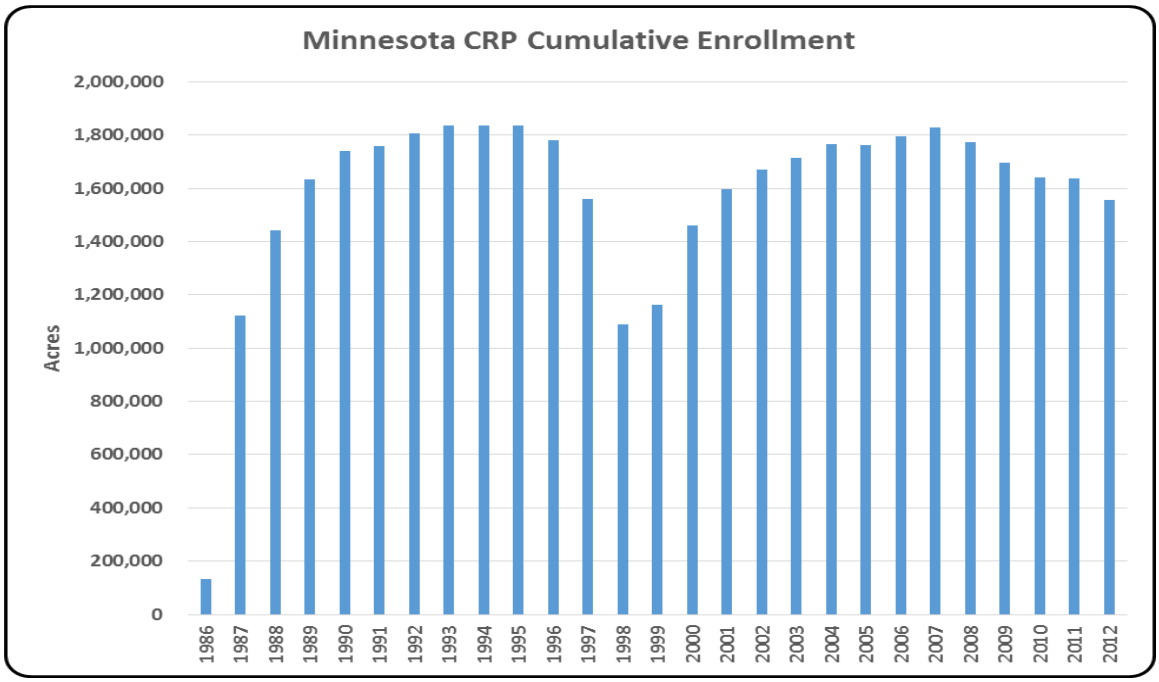


Figure 25, Minnesota CRP Cumulative Enrollment

Spatial Results

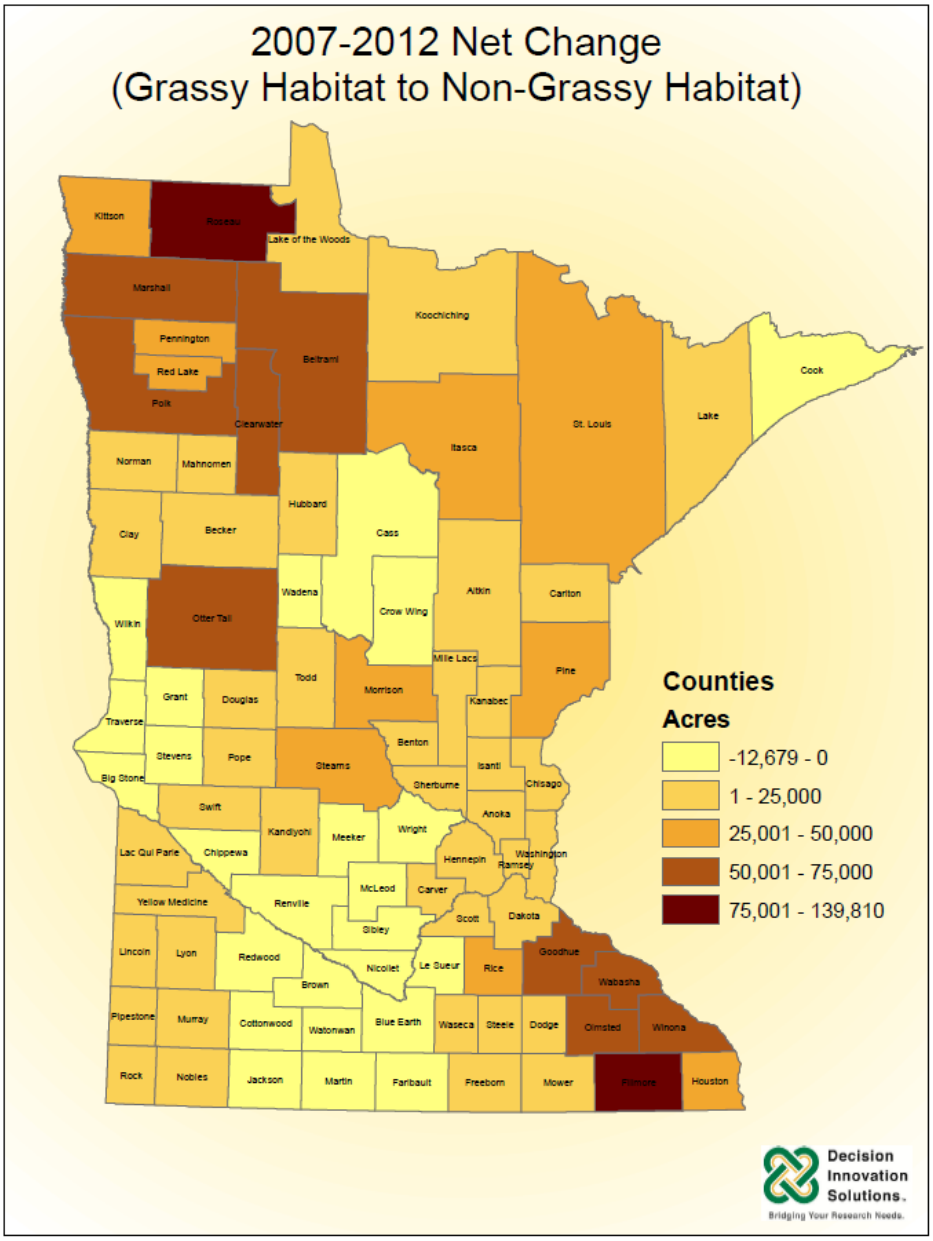


Figure 26, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Minnesota Counties

Referring to Figures 26-27 and Table 16, the spatial analysis for the Minnesota study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. Recall that in order to account for land use changes for both to and from the Grassy Habitat land use category, all land use changes are expressed on a net basis. Consequently, negative numbers can and do appear in both tables and charts associated with the Minnesota data. A negative number is interpreted as a net movement to Grassy Habitat. Four other states (Michigan,

Indiana, Illinois, and Iowa) in addition to Minnesota actually had a net movement to Grassy Habitat for several land use categories. Of the eight possible net changes from Habitat, two in Minnesota had a net movement to Grassy Habitat: Non-Ag (61 thousand acres) and Woody Habitat (92 thousand acres).

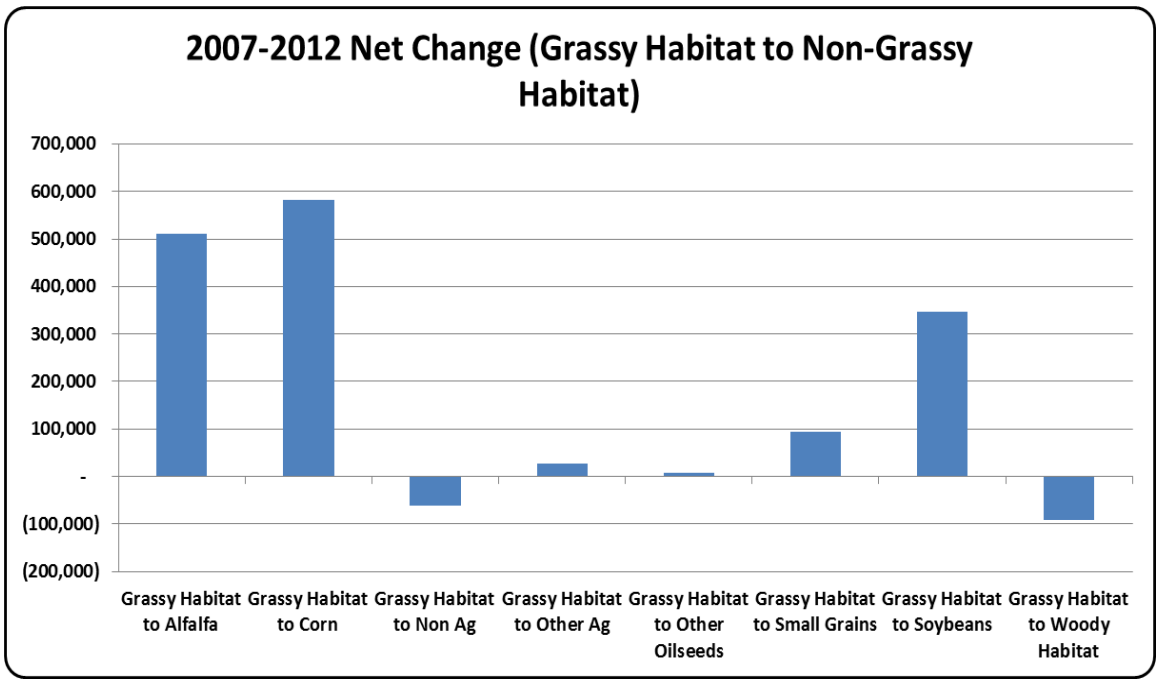


Figure 27, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Minnesota

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	511,791
Grassy Habitat to Corn	582,108
Grassy Habitat to Non Ag	(61,389)
Grassy Habitat to Other Ag	26,211
Grassy Habitat to Other Oilseeds	8,606
Grassy Habitat to Small Grains	93,175
Grassy Habitat to Soybeans	347,651
Grassy Habitat to Woody Habitat	(91,519)
Net Change FROM Grassy Habitat	1,416,635

Table 16, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Minnesota

Table 17 shows, in descending order, the degree to which changes occurred by land use type in Minnesota from 2007-2012. As shown in Table 17, the total net change (increase) in Habitat acreage across the Minnesota study area was 1.417 million acres. This represents 2.6 percent of total land in Minnesota. The majority of the net change from Grassy Habitat was to Corn (0.582 million acres),

Alfalfa (0.512 million acres), and Soybeans (0.348 million acres). Figure 28 shows annual totals for each land use category for the Minnesota study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Corn	582,108
Grassy Habitat to Alfalfa	511,791
Grassy Habitat to Soybeans	347,651
Grassy Habitat to Small Grains	93,175
Grassy Habitat to Other Ag	26,211
Grassy Habitat to Other Oilseeds	8,606
Grassy Habitat to Non Ag	(61,389)
Grassy Habitat to Woody Habitat	(91,519)
Net Change FROM Grassy Habitat	1,416,635

Table 17, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): Minnesota

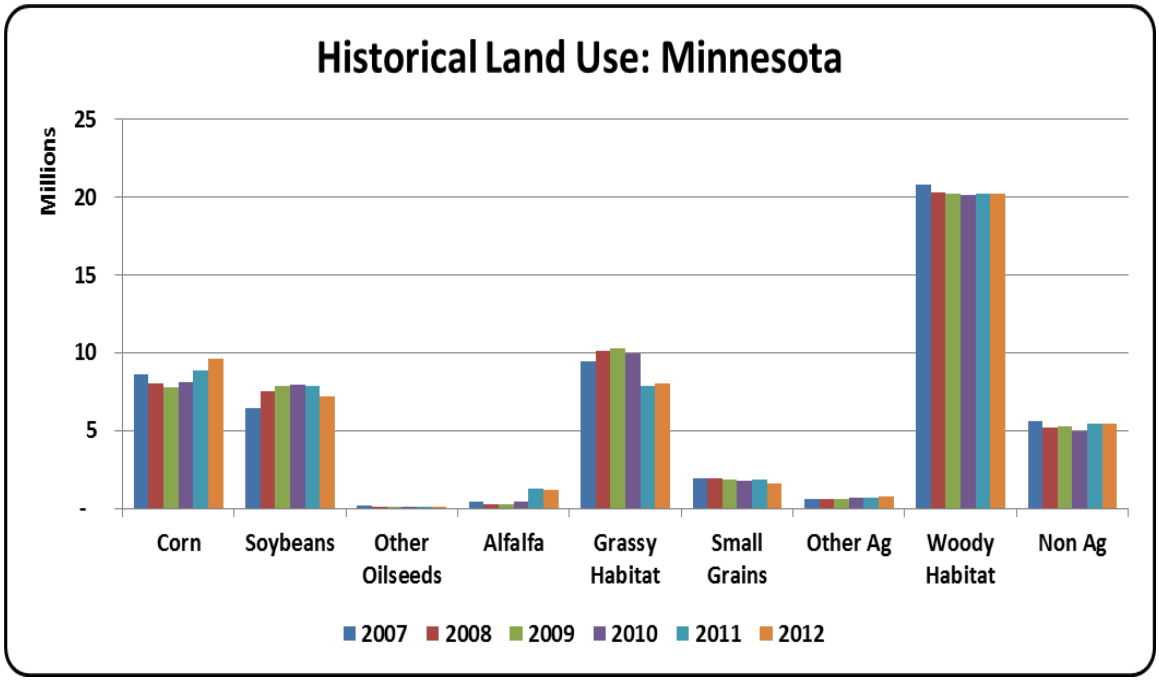


Figure 28, Historical Land Use: Minnesota

Observations

Due to the relatively low acreage of Other Oilseeds and Other Ag within Minnesota, we did not anticipate much of a shift from Grassy Habitat to these land use categories. Due to Minnesota's geography, shifts toward Corn, Soybeans, and Alfalfa were expected. Upon further inspection of the data, it appears that much of this land use conversion to Alfalfa has occurred on a diagonal from the northwest portion of the state to the southeast corner of the state.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed "program crops". This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 29-30 and Table 18. On a net basis, an estimated total of 1.023 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains. This represents 1.9 percent of total land in principal field crops in Minnesota. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the Minnesota Results section.

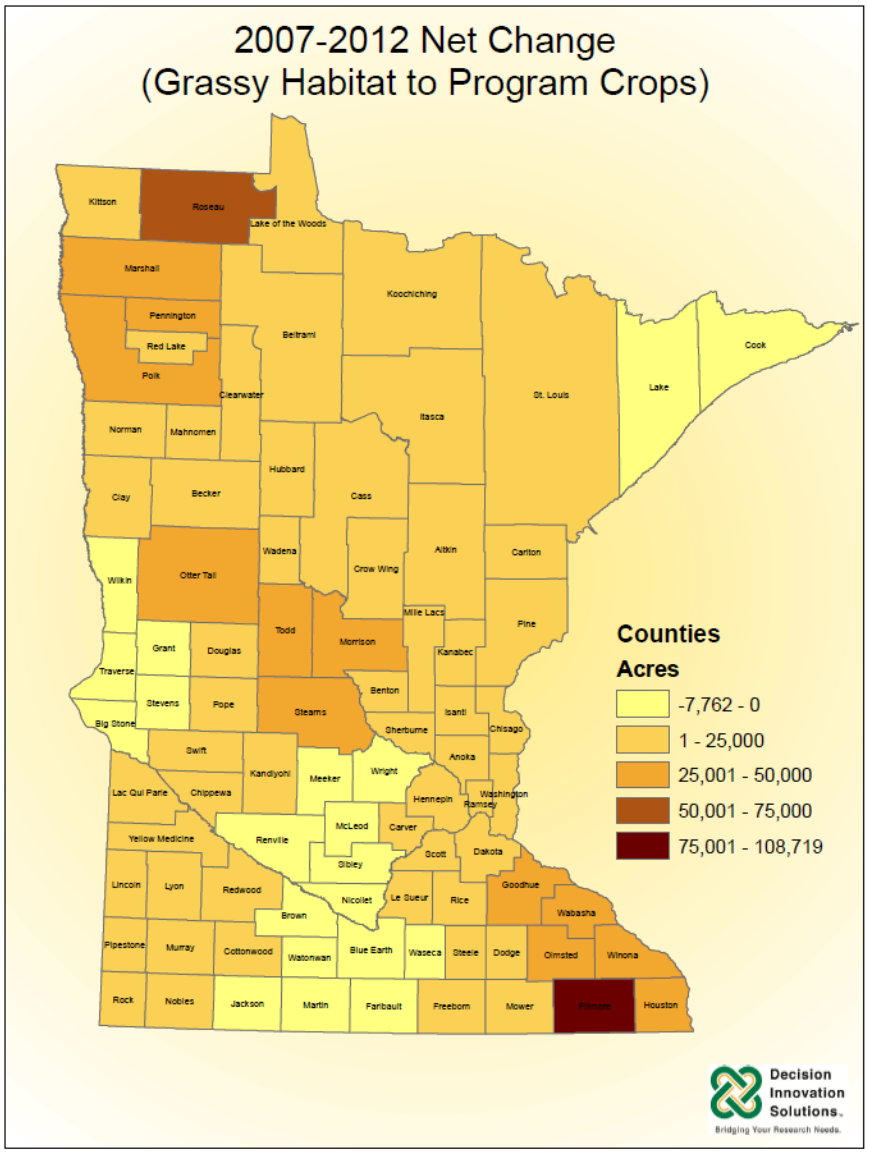


Figure 29, 2007-2012 Net Change (Grassy Habitat to Program Crops): Minnesota Counties

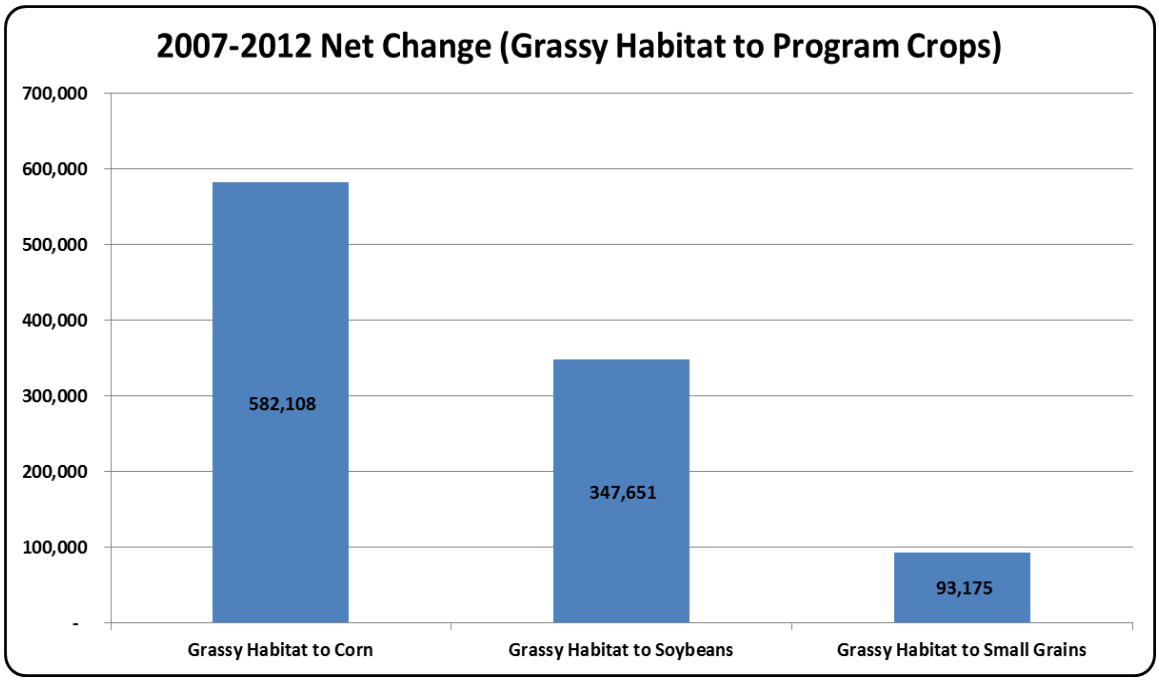


Figure 30, 2007-2012 Net Change (Grassy Habitat to Program Crops): Minnesota

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	582,108
Grassy Habitat to Soybeans	347,651
Grassy Habitat to Small Grains	93,175
Total Net Change to Program Crops	1,022,934

Table 18, 2007-2012 Net Change (Grassy Habitat to Program Crops): Minnesota

Econometric Results

Table 19 provides econometric results for Minnesota. A summary of econometric results with regard to the explanatory variables for Minnesota is provided below.

- **Crop Insurance Subsidies**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Crop Insurance Subsidy, the higher the share of land devoted to Grassy Habitat.
- **Net Returns**
  - Variable is significant at the 95% level and exhibits the expected sign (-).
    - Result suggests that the higher the Net Returns, the lower the share of land devoted to Grassy Habitat.

- **Growing Degree Days**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Growing Degree Days, the higher the share of land devoted to Grassy Habitat.
- **Precipitation**
  - Variable is insignificant at the 95% level and *does not* exhibit the expected sign (-).
    - Due to insignificance, no explanatory power is gleaned from the Precipitation variable with regards to its impact on the share of land devoted to Grassy Habitat.

Table 19, Econometric Results: Minnesota

OLS Regression Statistics for GrassHab Ratio, 6/20/2013 5:39:10 PM					
F-test	10.162	**Prob(F)**	0.000	**Unrestricted Model**	
MSE1/2	0.110	**CV Regr**	57.685	**F-test**	10.162
R2	0.073	**Durbin-Watson**	2.456	**R2**	0.073
RBar2	0.066	**Rho**	-0.229	**RBar2**	0.066
Akaike Information Criterion	-4.415	**Goldfeld-Quandt**	1.569	**Akaike Information Criterion**	-4.415
Schwarz Information Criterion	-4.382			**Schwarz Information Criterion**	-4.382
95%	**Intercept**	**CIS**	**RET**	**GDD**	**Precip**
Beta	0.000	**0.002**	**0.000**	**0.130**	0.034
S.E.	0.055	0.001	0.000	0.052	0.022
t-test	0.008	4.779	-4.876	2.496	1.525
Prob(t)	0.994	0.000	0.000	0.013	0.128
Elasticity at Mean		0.380	-0.245	0.683	0.180
Variance Inflation Factor		1.494	2.147	2.558	1.279
Partial Correlation		0.206	-0.210	0.109	0.067
Semipartial Correlation		0.202361454	-0.206468272	0.105700269	0.06456107
Restriction					

The model results for Minnesota illustrates the impact higher net returns have had on the share of land devoted to Grassy Habitat. However, the Net Returns variable is the only variable which exhibited both significance and the expected sign. As with other states under study in this analysis, this illustrates the complexity of reducing the issue to just a few variables. Further, the overstatement of grassland by CDL issue explored earlier may also be confounding these results.

IOWA

Background

In terms of a historical perspective on the land use in Iowa, acreage in farms for the area has ranged from a low of 23.6 million acres in 1995 to a high of 25.0 million acres in 2000. Estimated acreage devoted to principal field crops (corn, soybeans, hay, oats, and wheat) in 2012 (24.8 million acres) is the third highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 69.5 percent of land acres in Iowa, the highest of all states in the 7-state study area. Referring to Figure 31, after a temporary decline from a recent peak in 2008, acreage has begun a moderately increasing trend.

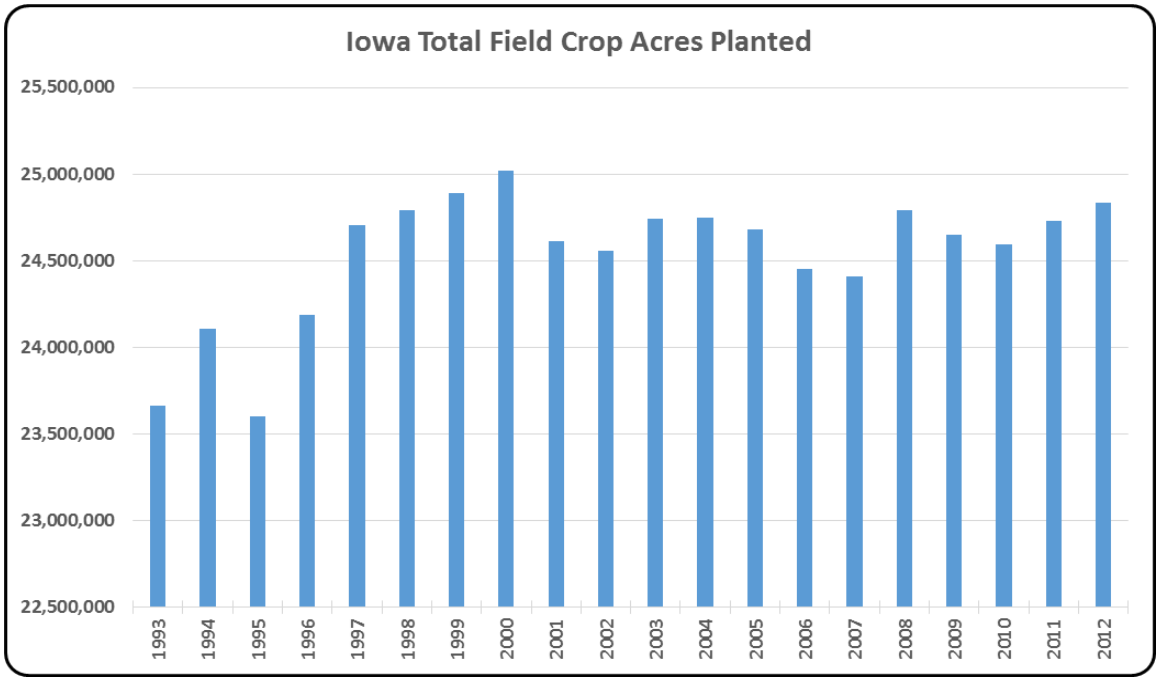


Figure 31, Iowa Total Field Crop Planted Acres

Referring to Figure 32, CRP caught on quickly in Iowa as enrolled acres exceeded 2.0 million in the seventh year of the program. In 1996 the first of the ten-year contracts began to expire; acres enrolled subsequently dropped to around 1.5 million. There had been a steady increase since then until 2007, but never to exceed the highs of the early 1990s. Higher crop prices and the need for suitable land to be farmed are reasons for the decline over the past few years. Iowa acres enrolled in the CRP program in 2012 represent 6.6 percent of total farmland in principal crops in the state.

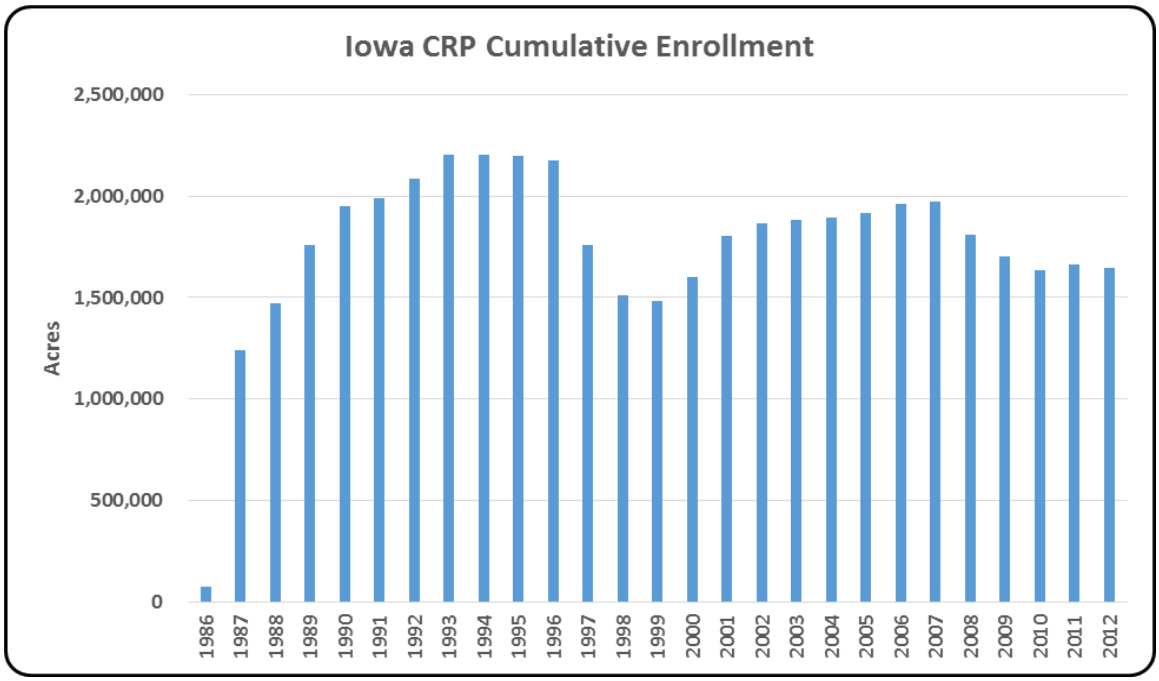


Figure 32, Iowa CRP Cumulative Enrollment

Spatial Results

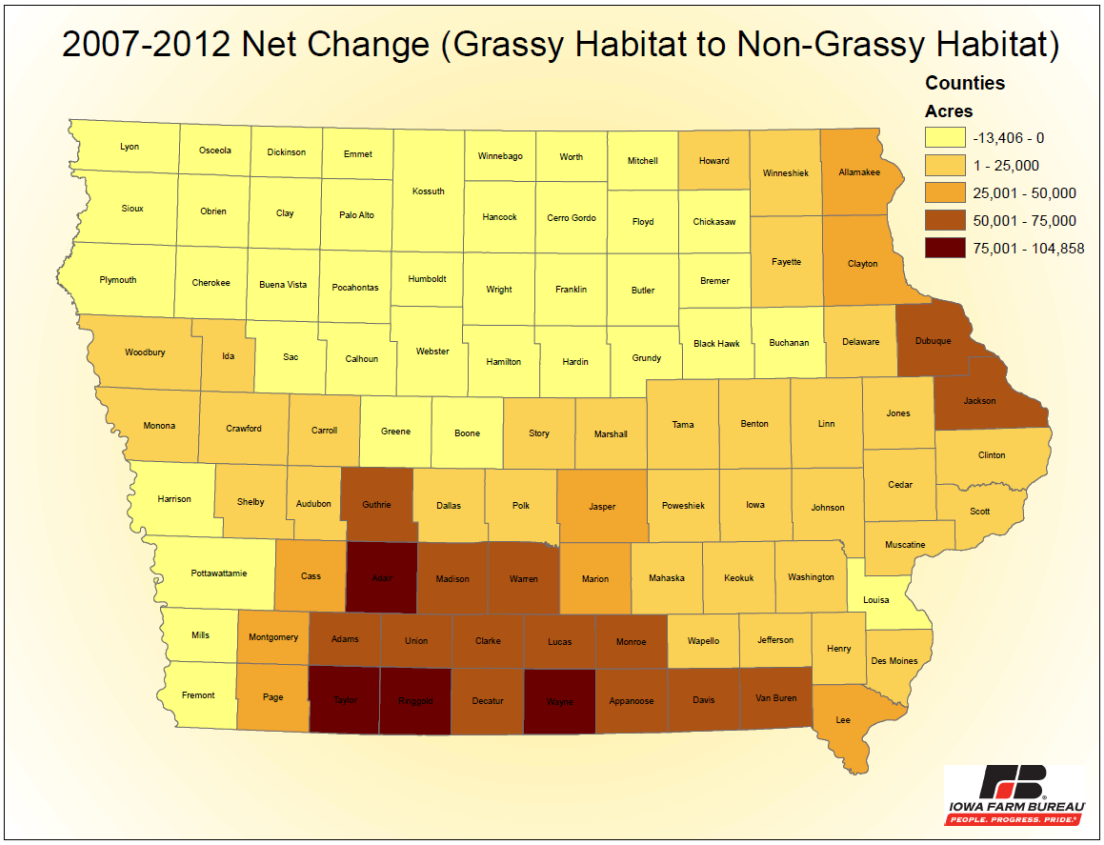


Figure 33, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Iowa Counties

Referring to Figure 33-34 and Table 20, the spatial analysis for the Iowa study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. Recall that in order to account for land use changes for both to and from the Grassy Habitat land use category, all land use changes are expressed on a net basis. Consequently, negative numbers can and do appear in both tables and charts associated with the Iowa data. A negative number is interpreted as a net movement to Grassy Habitat. Other states in addition to Iowa actually had a net movement to Grassy Habitat for several land use categories. Of the eight possible net changes from Grassy Habitat, two (Non Ag and Other Oilseeds) had a net movement to Grassy Habitat in Iowa.

The change in the CRP program from a focus on whole farm enrollments to a program that is more targeted at water quality and wildlife benefits (i.e., one that utilize more stream bank buffer strips) may account for the fact that 40 of Iowa's 99 counties experienced a net gain in Grassy Habitat while some of the counties that had significant whole farm enrollments experienced net losses in grassy habitat.

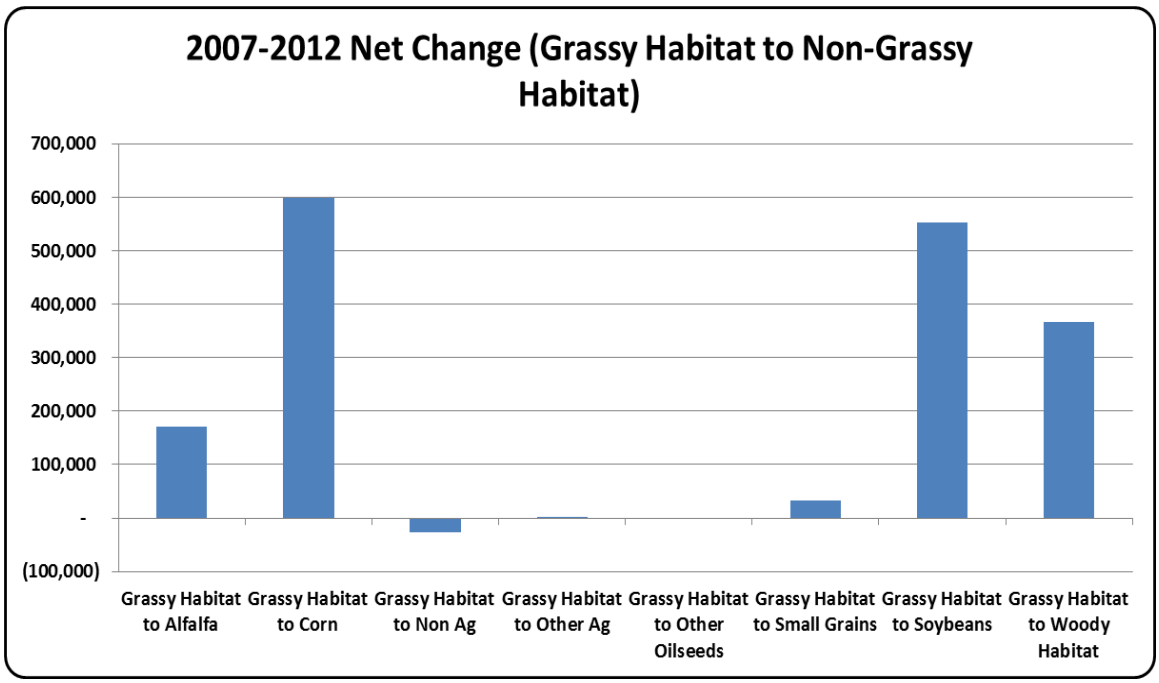


Figure 34, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Iowa

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	170,640
Grassy Habitat to Corn	598,692
Grassy Habitat to Non Ag	(26,500)
Grassy Habitat to Other Ag	1,061
Grassy Habitat to Other Oilseeds	(10)
Grassy Habitat to Small Grains	33,364
Grassy Habitat to Soybeans	553,597
Grassy Habitat to Woody Habitat	366,385
Net Change FROM Grassy Habitat	1,697,229

Table 20, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Iowa

Table 21 shows, in descending order of degree to which changes occurred by land use type, a summary of our estimates for land use change in Iowa from 2007-2012. As shown in Table 21, the total net change in Grassy Habitat across the Iowa study area was 1.697 million acres. This represents 4.7 percent of total land in the Iowa. The majority of this net change to Grassy Habitat was to corn (0.599 million acres). Other land use categories that experienced acreage gain at the expense of Grassy Habitat were: Soybeans (0.554 million acres), Woody Habitat (0.366 million acres), and Alfalfa (0.171 million acres). Figure 35 shows annual totals for each land use category for the Iowa study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Corn	598,692
Grassy Habitat to Soybeans	553,597
Grassy Habitat to Woody Habitat	366,385
Grassy Habitat to Alfalfa	170,640
Grassy Habitat to Small Grains	33,364
Grassy Habitat to Other Ag	1,061
Grassy Habitat to Other Oilseeds	(10)
Grassy Habitat to Non Ag	(26,500)
Net Change FROM Grassy Habitat	1,697,229

Table 21, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): Iowa

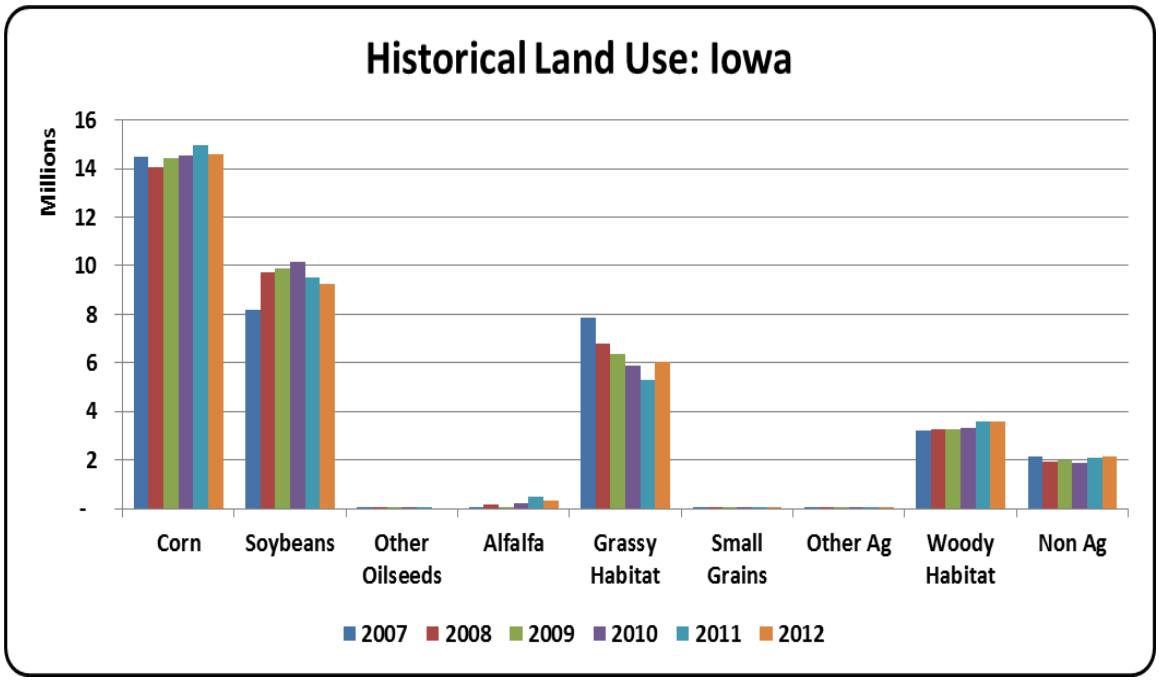


Figure 35, Historical Land Use: Iowa

Observations

Due to the relatively low acreage of Other Oilseeds and Other Ag within Iowa, we did not anticipate much of a shift from Grassy Habitat to these land use categories. Given the degree to which Iowa produces corn and soybeans, we did suspect there would be shifts toward these land use categories. The shift of grassy habitat acres to corn and soybeans is in roughly the same proportion that corn and soybean acres exist within the state reflecting the predominance of a corn-soybean rotation for cropped land in Iowa.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed “program crops”. This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 36-37 and Table 22. On a net basis, an estimated total of 1.186 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains. This represents 3.3 percent of total land in principal field crops in Iowa. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the Iowa Results section.

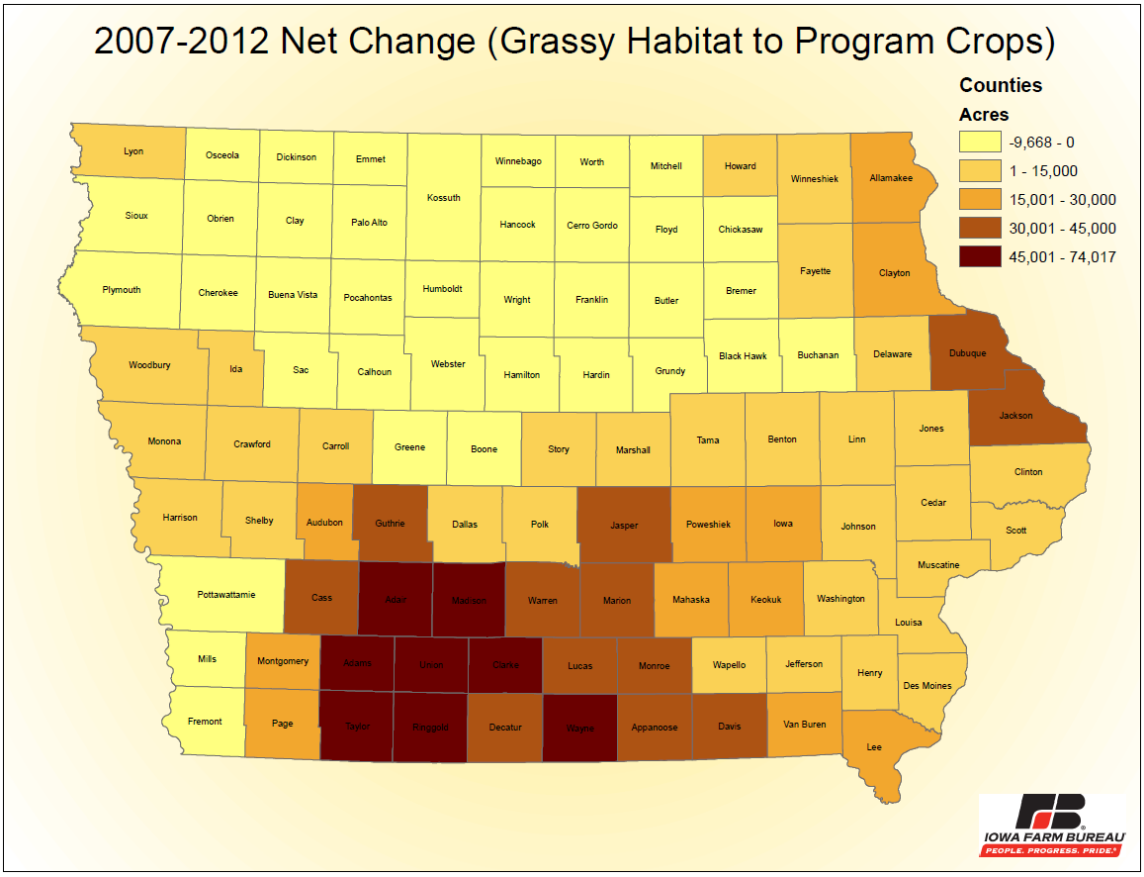


Figure 36, 2007-2012 Net Change (Grassy Habitat to Program Crops): Iowa Counties

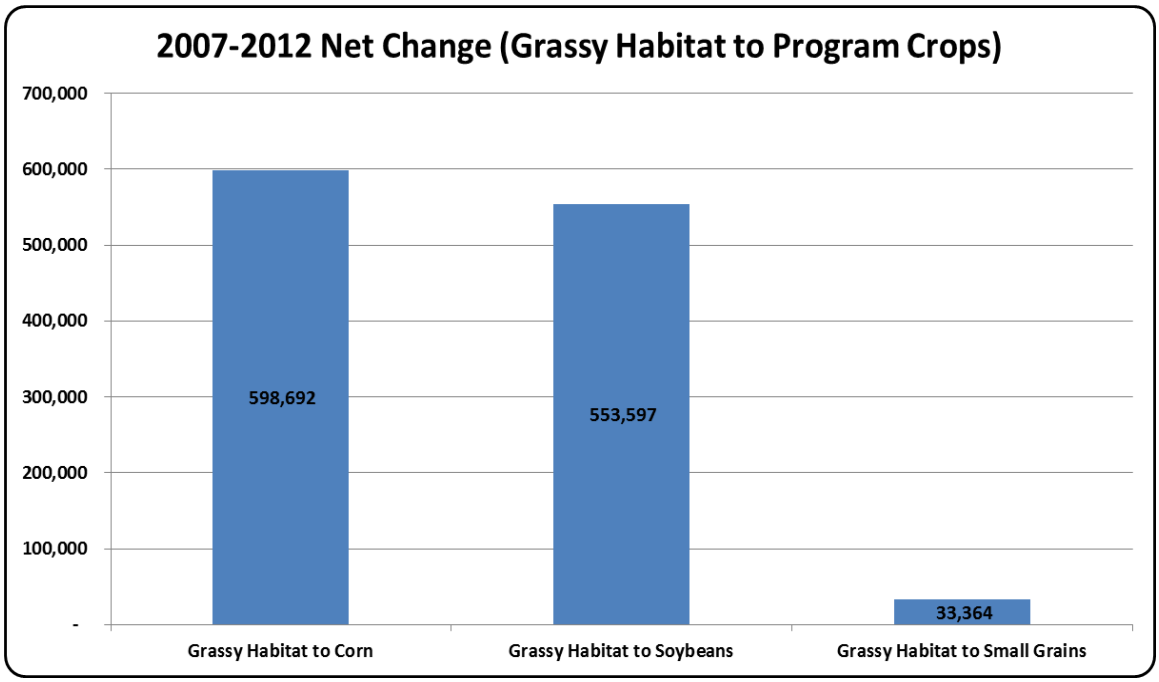


Figure 37, 2007-2012 Net Change (Grassy Habitat to Program Crops): Iowa

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	598,692
Grassy Habitat to Soybeans	553,597
Grassy Habitat to Small Grains	33,364
Total Net Change to Program Crops	1,185,653

Table 22, 2007-2012 Net Change (Grassy Habitat to Program Crops): Iowa

Econometric Results

Table 23 provides results for Iowa. A summary of econometric results with regard to the explanatory variables for Iowa is provided below.

- **Crop Insurance Subsidies**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Crop Insurance Subsidy, the higher the share of land devoted to Grassy Habitat.
- **Net Returns**
  - Variable is significant at the 95% level and exhibits the expected sign (-).
    - Result suggests that the higher the net Returns, the lower the share of land devoted to Grassy Habitat.
- **Growing Degree Days**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Growing Degree Days, the higher the share of land devoted to Grassy Habitat. This may be due to the dominance of physical characteristics of the landscape in which the more rolling, hilly landscapes are in the southern part of the state which has higher Growing Degree Days than does the northern part of the state.
- **Precipitation**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Precipitation, the higher the share of land devoted to Grassy Habitat.

Table 23, Econometric Results: Iowa

OLS Regression Statistics for GrassHab Ratio, 6/20/2013 6:16:24 PM					
F-test	107.300	**Prob(F)**	0.000	**Unrestricted Model**	
MSE1/2	0.105	**CV Regr**	58.036	**F-test**	107.300
R2	0.422	**Durbin-Watson**	1.469	**R2**	0.422
RBar2	0.418	**Rho**	0.262	**RBar2**	0.418
Akaike Information Criterion	-4.494	**Goldfeld-Quandt**	3.036	**Akaike Information Cr**	-4.494
Schwarz Information Criterion	-4.464			**Schwarz Information C**	-4.464
95%	**Intercept**	**CIS**	**RET**	**GDD**	**Precip**
Beta	**-0.665**	**0.011**	**0.000**	**0.452**	**0.193**
S.E.	0.047	0.001	0.000	0.047	0.020
t-test	-14.057	14.340	-5.522	9.665	9.539
Prob(t)	0.000	0.000	0.000	0.000	0.000
Elasticity at Mean		1.330	-0.220	2.488	1.062
Variance Inflation Factor		1.041	2.060	1.718	1.397
Partial Correlation		0.509	-0.222	0.370	0.366
Semipartial Correlation		0.449414345	-0.173063323	0.302899248	0.298931155
Restriction					

The model results for Iowa show that whereas all variables were significant, Net Returns is the only variable which exhibited both significance and the expected sign. A possible explanation for unexpected signs for Crop Insurance Subsidies, Growing Degree Days, and Precipitation lies in how Iowa's landscape changes spatially. As one moves from north to south, Growing Degree Days increase. As one moves from northwest to southeast, precipitation increases. Additionally, the landscape in southern Iowa is considerably hillier than the rest of the state, which has implications for the magnitude of crop insurance subsidies that are available to crop producers. We would expect the combination of these three unique characteristics to have an impact, both in terms of significance and the type of impact (expected sign). Further, the "overstatement of grassland by CDL" issue explored earlier may also be confounding these results.

ILLINOIS

Background

In terms of a historical perspective on the land use in Illinois, acreage in farms for the area has ranged from a low of 22.7 million acres in 2010 to a high of 23.8 million acres in 1996. Estimated acreage devoted to principal field crops (corn, soybeans, wheat, hay, oats, and sorghum) in 2012 (23.2 million acres) is the fifteenth highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 65.1 percent of land acres in Illinois. Referring to Figure 38, the overall trend since 1996 in terms of land devoted to the planting of field crops has been a steady decline. Only since 2011 has acreage planted to field crops in Illinois begun to increase.

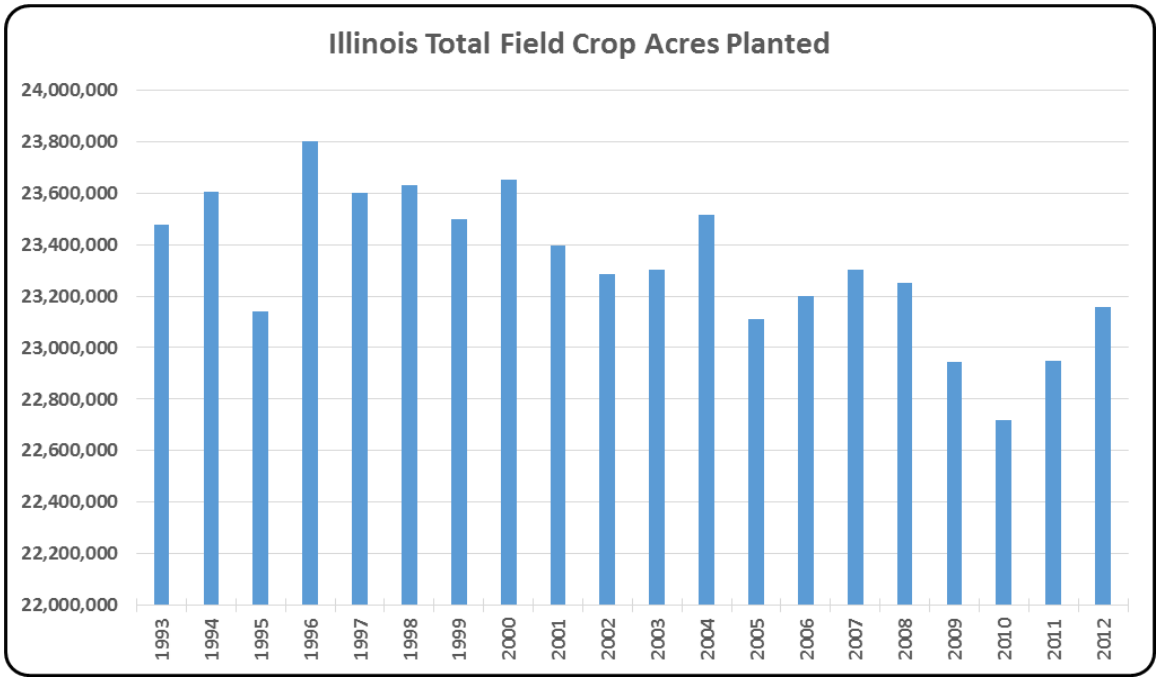


Figure 38, Illinois Total Field Crop Acres Planted

Referring to Figure 39, Illinois has seen a steady increase from the implementation of the CRP program until the mid-1990s. There was a slight decline to around 0.7 million acres as the first round of 10-year contracts expired, but since then Illinois has continued to increase the number of acres enrolled until 2007. The past few years' enrollment has suffered slightly, but they are still over 1.0 million acres enrolled. Illinois acres enrolled in the CRP program in 2012 represent 4.4 percent of total farmland in principal crops in the state.

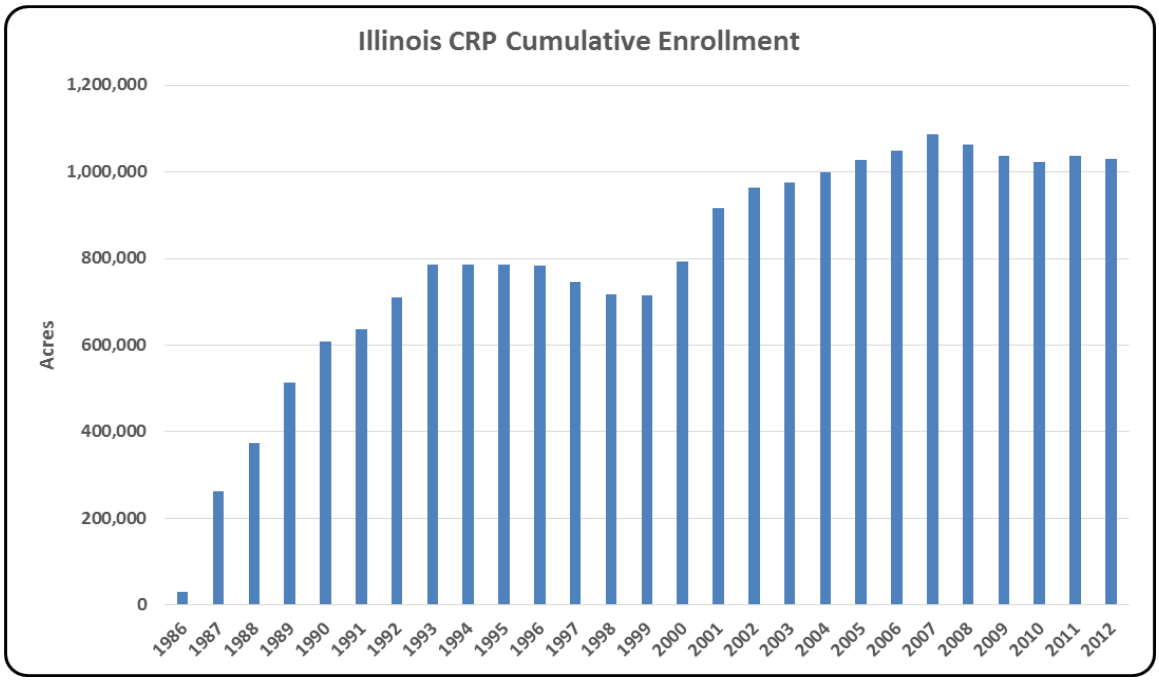


Figure 39, Illinois CRP Cumulative Enrollment

Spatial Results

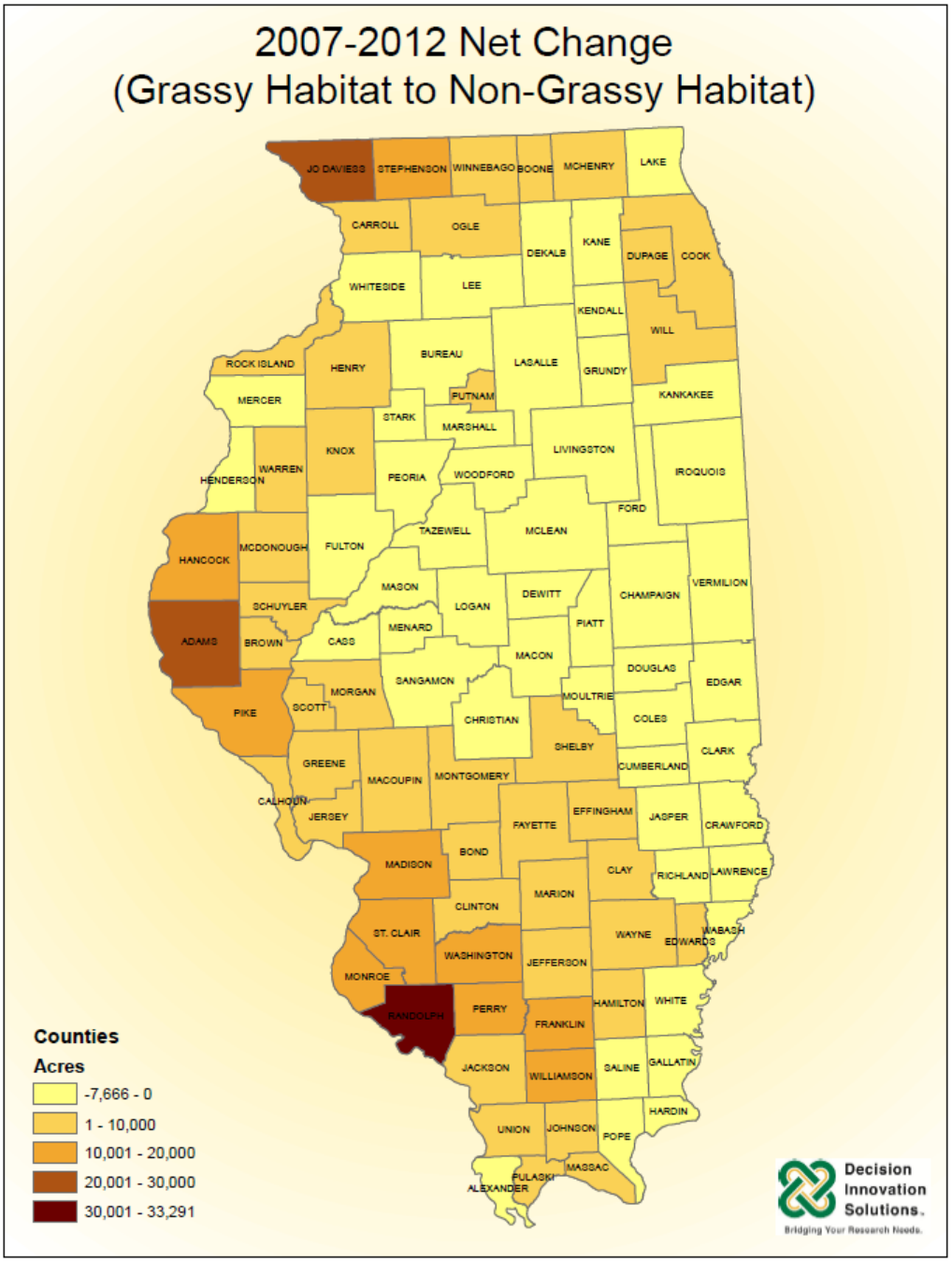


Figure 40, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Illinois Counties

Referring to Figures 40-41 and Table 24, the spatial analysis for the Illinois study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. According to the analysis, there was a relatively small, but positive net land use change from the Grassy Habitat land use category to other categories. The majority of this net land use

change from Grassy Habitat was toward Corn and Soybeans. Interestingly, 50 Illinois counties experienced net increases in grassy habitat during the study period. This may reflect a change in focus of the CRP program, which is to focus more on stream buffers and targeted CRP enrollments. This change in focus tends to have a more targeted, positive influence on water quality and less focus on crop supply management through whole farm enrollments.

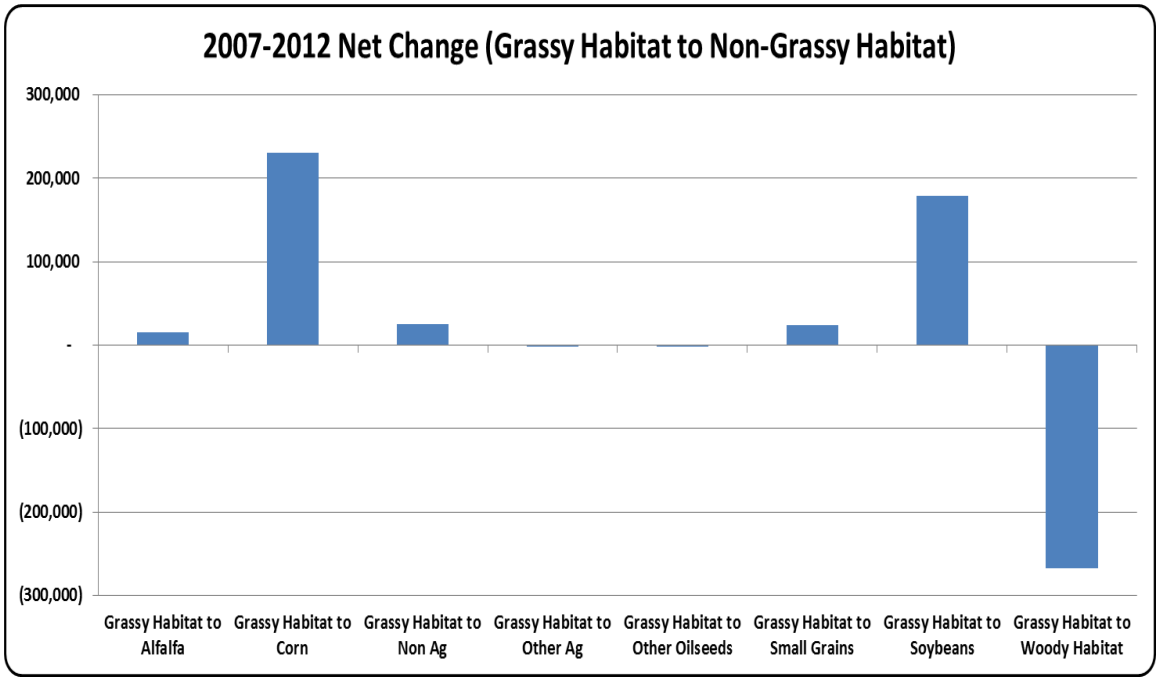


Figure 41, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Illinois

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	15,266
Grassy Habitat to Corn	230,435
Grassy Habitat to Non Ag	25,714
Grassy Habitat to Other Ag	(640)
Grassy Habitat to Other Oilseeds	(1)
Grassy Habitat to Small Grains	23,758
Grassy Habitat to Soybeans	179,657
Grassy Habitat to Woody Habitat	(267,445)
Net Change FROM Grassy Habitat	206,744

Table 24, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Illinois

Table 25 shows, in descending order of degree to which changes occurred by land use type, a summary of our estimates for net land use change in Illinois from 2007-2012. As shown in Table 25, the total net change in Habitat acreage across the Illinois study area was 0.207 million acres. This represents 0.6

percent of total land in the Illinois. The majority of this net land use change from Grassy Habitat was toward Corn (0.230 million acres), followed by Soybeans (0.180 million acres). Interestingly, there was a moderate shift of Woody Habitat toward Grassy Habitat. A likely explanation for this movement is due to natural changes in land characteristics from the end points of the study period (2007 and 2012) and/or better land classification capabilities within the CDL data. Figure 42 shows annual totals for each land use category for the Illinois study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Corn	230,435
Grassy Habitat to Soybeans	179,657
Grassy Habitat to Non Ag	25,714
Grassy Habitat to Small Grains	23,758
Grassy Habitat to Alfalfa	15,266
Grassy Habitat to Other Oilseeds	(1)
Grassy Habitat to Other Ag	(640)
Grassy Habitat to Woody Habitat	(267,445)
Net Change FROM Grassy Habitat	206,744

Table 25, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): Illinois

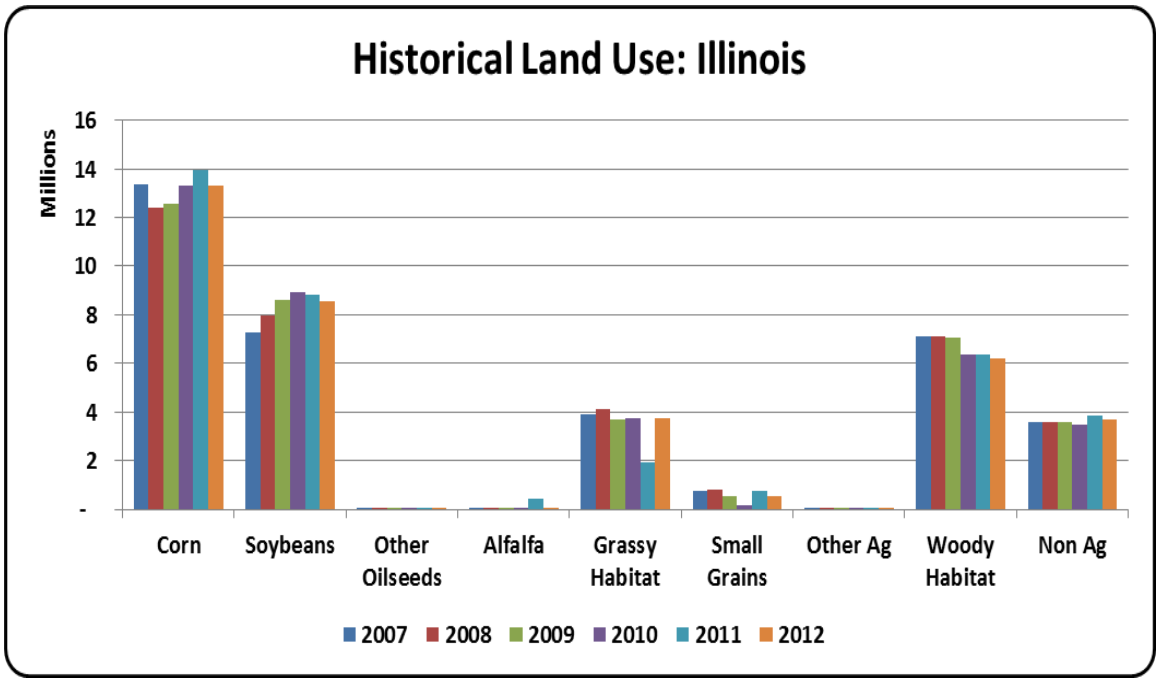


Figure 42, Historical Land Use: Illinois

Observations

Due to the relatively low acreage of Other Oilseeds and Other Ag within Illinois, we did not anticipate much of a shift from Grassy Habitat to these land use categories. As suspected, our estimates suggest

that there were shifts of Habitat acreage toward Corn and Soybeans. However, net land use changes in Illinois from Habitat to Corn and Soybeans were on a smaller scale when compared to other states in the 7-state study area.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed "program crops". This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 43-44 and Table 26. On a net basis, an estimated total of 0.434 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains. This represents 1.2 percent of total land in principal field crops in Illinois. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the Illinois Results section.

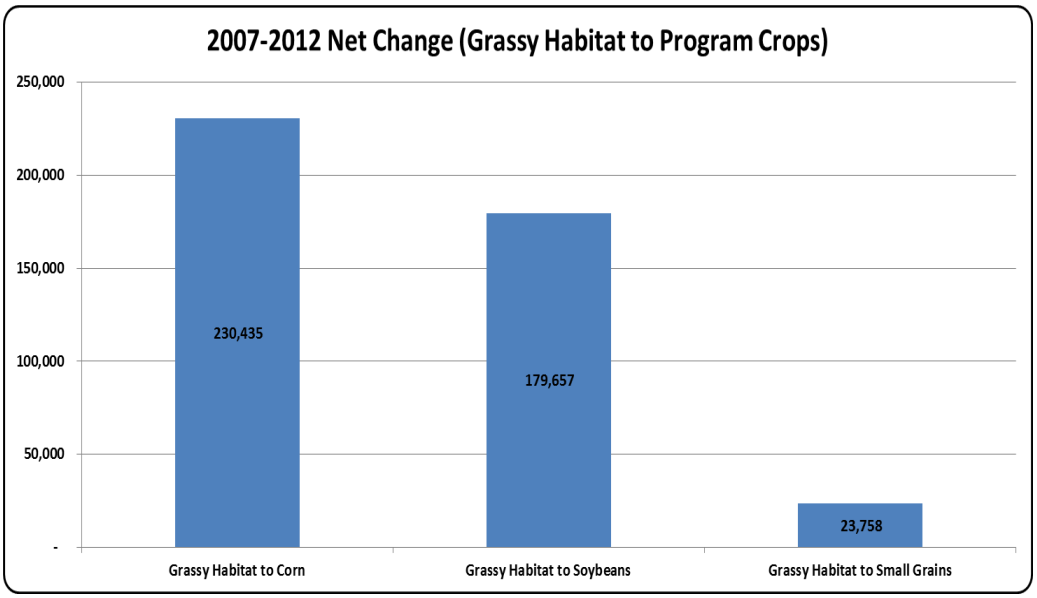


Figure 43, 2007-2012 Net Change (Grassy Habitat to Program Crops): Illinois

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	230,435
Grassy Habitat to Soybeans	179,657
Grassy Habitat to Small Grains	23,758
Total Net Change to Program Crops	433,850

Table 26, 2007-2012 Net Change (Grassy Habitat to Program Crops): Illinois

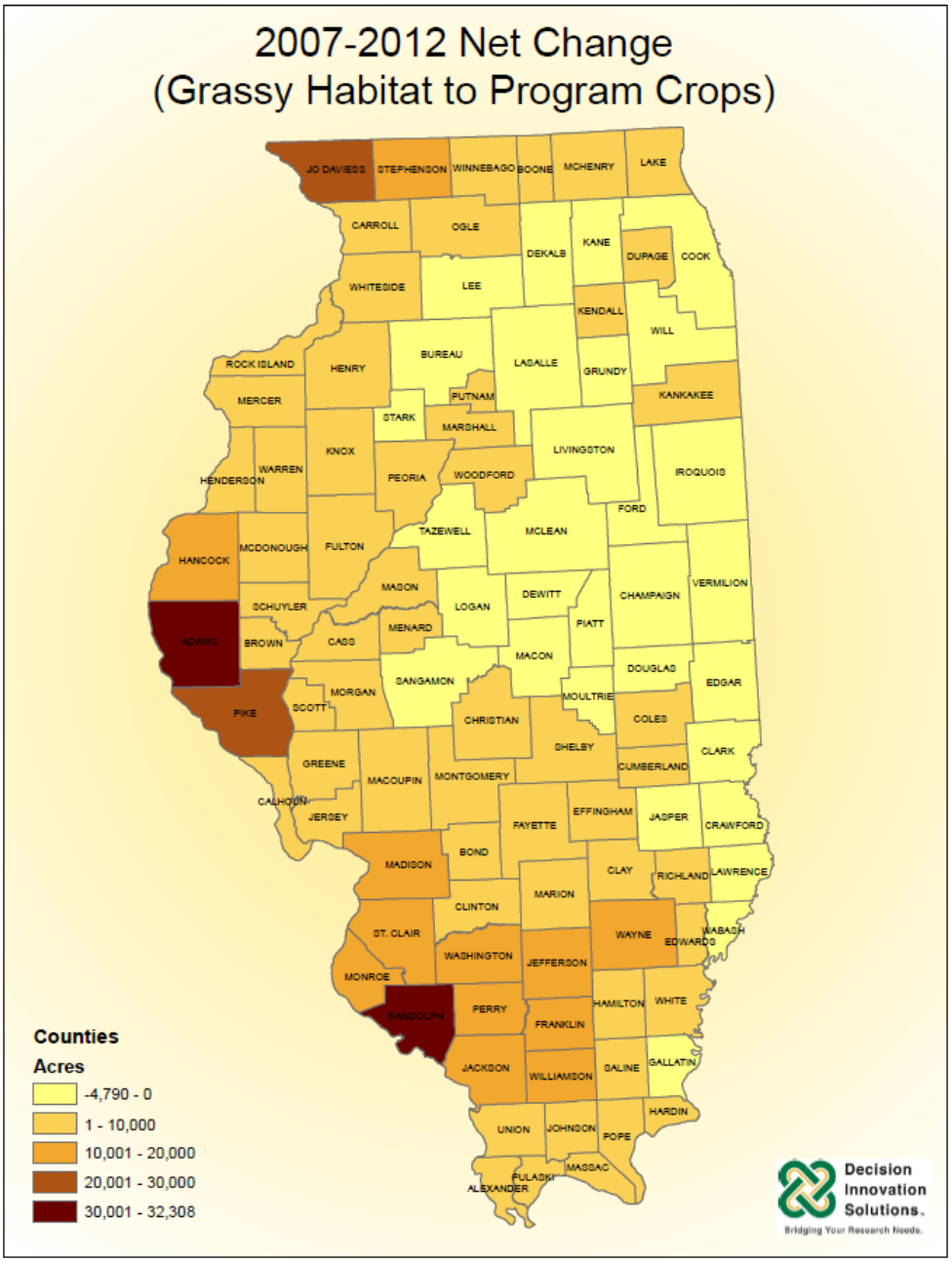


Figure 44, 2007-2012 Net Change (Grassy Habitat to Program Crops): Illinois Counties

Econometric Results

Table 27 provides results for Illinois. A summary of econometric results with regard to the explanatory variables for Illinois is provided below.

- **Crop Insurance Subsidies**

- Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
  - Result suggests that the higher the Crop Insurance Subsidy, the higher the share of land devoted to Grassy Habitat.

- **Net Returns**
  - Variable is significant at the 95% level and exhibits the expected sign (-).
    - Result suggests that the higher the Net Returns, the lower the share of land devoted to Grassy Habitat.
- **Growing Degree Days**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Growing Degree Days, the higher the share of land devoted to Grassy Habitat.
- **Precipitation**
  - Variable is significant at the 95% level and exhibits the expected sign (-).
    - Result suggests that the higher the Precipitation, the lower the share of land devoted to Grassy Habitat.

Table 27, Econometric Results: Illinois

OLS Regression Statistics for GrassHab Ratio, 6/21/2013 11:06:54 AM					
F-test	32.478	**Prob(F)**	0.000	**Unrestricted Model**	
MSE1/2	0.067	**CV Regr**	64.754	**F-test**	32.478
R2	0.176	**Durbin-Watson**	1.650	**R2**	0.176
RBar2	0.171	**Rho**	0.173	**RBar2**	0.171
Akaike Information Criterion	-5.399	**Goldfeld-Quandt**	1.563	**Akaike Information Cr**	-5.399
Schwarz Information Criterion	-5.370			**Schwarz Information C**	-5.370
95%	**Intercept**	**CIS**	**RET**	**GDD**	**Precip**
Beta	-0.003	**0.002**	**0.000**	**0.137**	**-0.043**
S.E.	0.030	0.000	0.000	0.023	0.016
t-test	-0.096	5.971	-7.171	5.970	-2.723
Prob(t)	0.924	0.000	0.000	0.000	0.007
Elasticity at Mean		0.499	-0.378	1.325	-0.418
Variance Inflation Factor		1.128	1.857	1.137	1.973
Partial Correlation		0.236	-0.279	0.235	-0.110
Semipartial Correlation		0.219940122	-0.264156087	0.21991909	-0.100320171
Restriction					

The model results for Illinois show that whereas all variables were significant, Net Returns and Precipitation are the only variables which exhibited both significance and the expected sign. There are likely underlying spatial characteristics (landscape changes spatially from north to south) at work in Illinois with regard to explaining changes in land devoted to Grassy Habitat. Additionally, the model may have difficulty explaining the relatively low (when compared to other states in the study area) net

change from Grassy Habitat. Further, the "overstatement of grassland by CDL" issue explored earlier may also be confounding these results.

INDIANA

Background

In terms of a historical perspective on the land use in Indiana, acreage in farms for the area has ranged from a low of 11.9 million acres in 1995 to a high of 12.9 million acres in 1998. Estimated acreage devoted to principal field crops (corn, soybeans, wheat, oats, mint crops, and melons) in 2012 (12.4 million acres) is the seventh highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 54.0 percent of land acres in Indiana. Referring to Figure 45, 2012 acreage devoted to the planting of field crops is within the range of acres for this purpose since the year 2002.

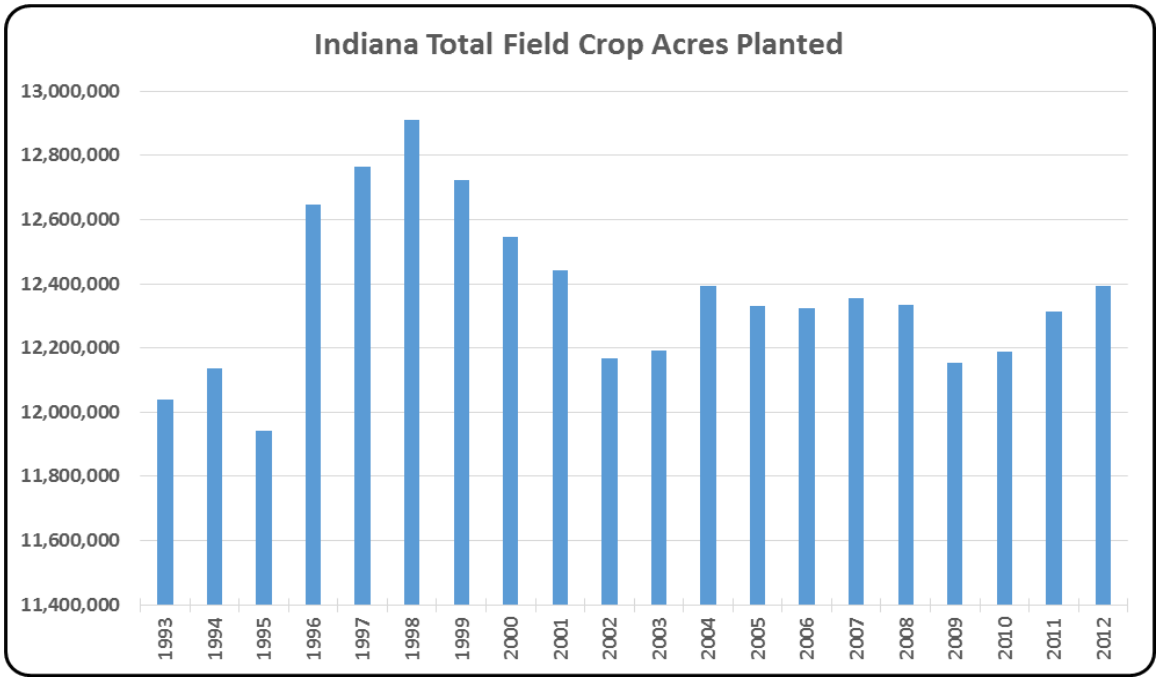


Figure 45, Indiana Total Field Crop Acres Planted

Referring to Figure 46, Indiana has not seen the level of enrollment in the CRP program as other states such as Iowa, Nebraska and Illinois. Since the implementation of the program, Indiana had steady increases until the mid-1990s and reached 0.453 million acres. Since the first round of 10-year contracts expired, the enrollment in the program has held fairly steady around the 0.300 million mark. Indiana acres enrolled in the CRP program in 2012 represent 2.3 percent of total farmland in principal crops in the state.

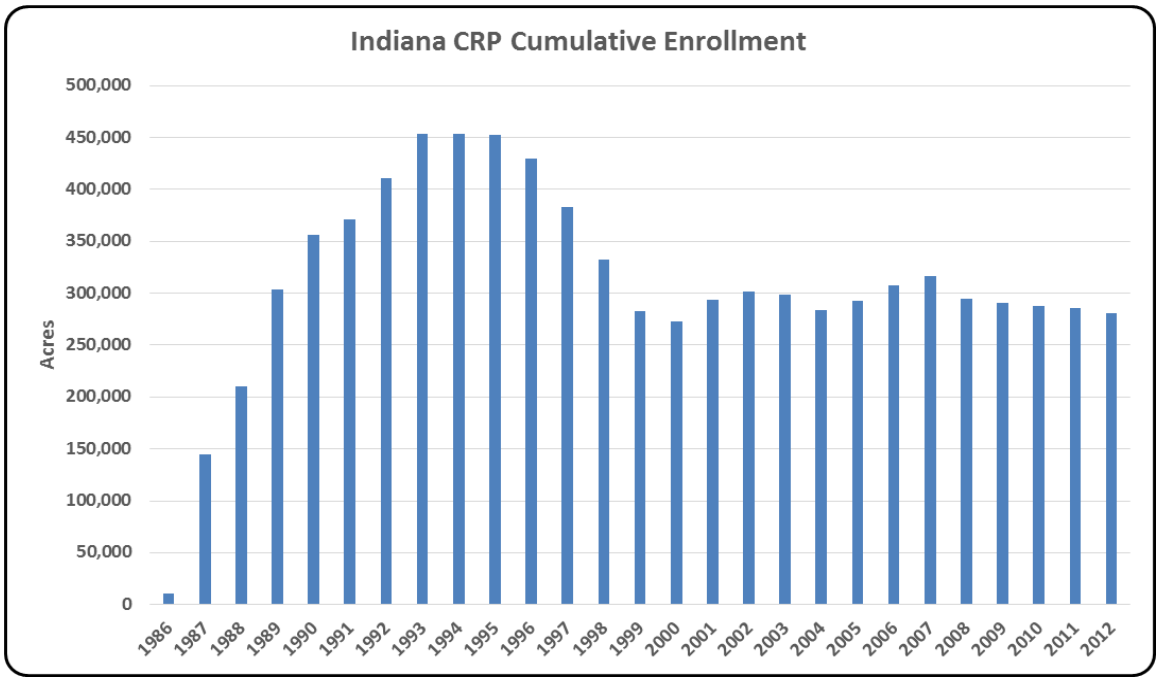


Figure 46, Indiana CRP Cumulative Enrollment

Spatial Analysis

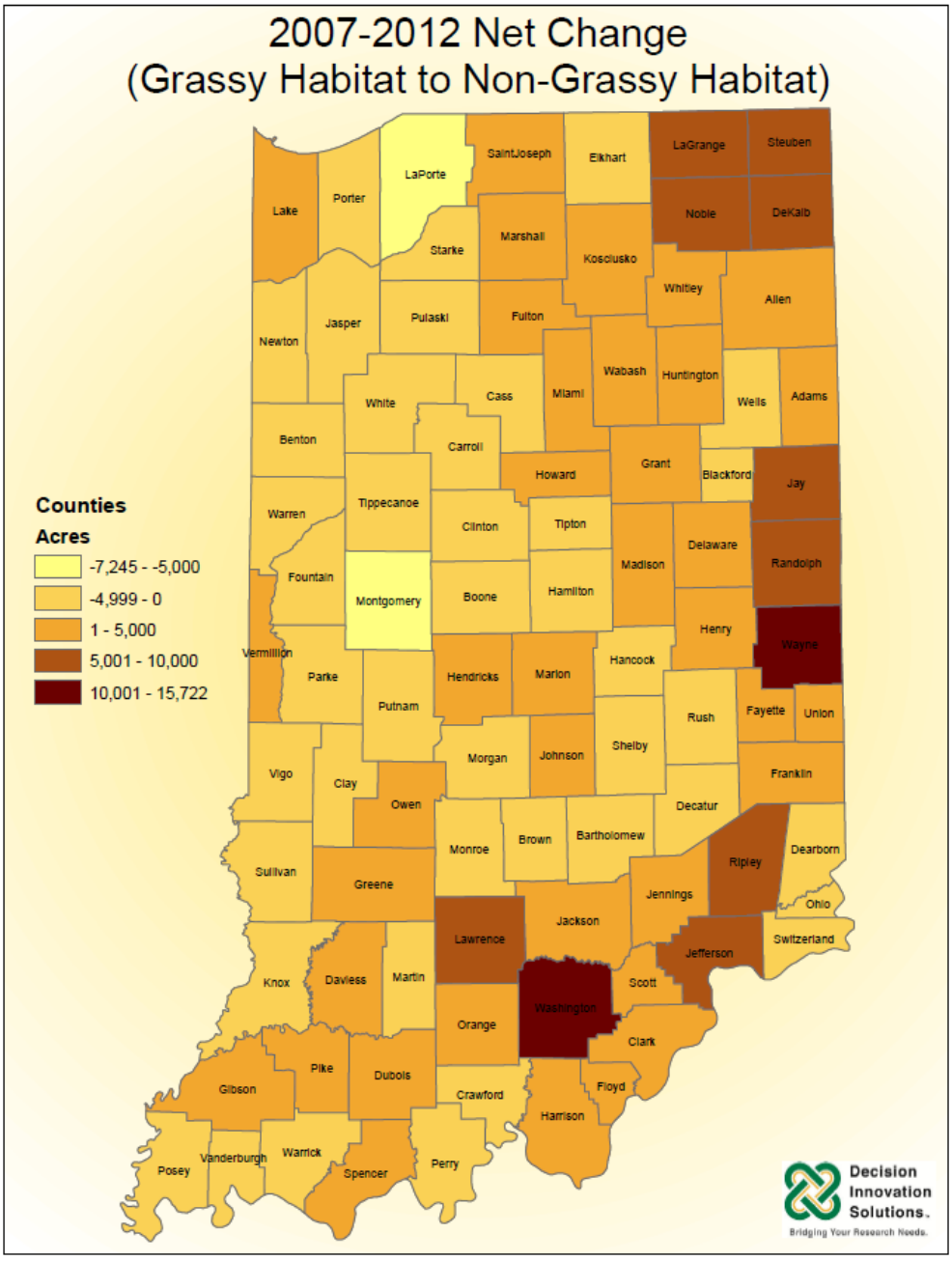


Figure 47, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Indiana Counties

Referring to Figures 47-48 and Table 28, the spatial analysis for the Indiana study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. Recall that in order to account for land use changes for both to and from the Grassy Habitat land use category, all land use changes are expressed on a net basis. Consequently, negative numbers can and do appear in both tables and charts associated with the Indiana data. A

negative number is interpreted as a net movement to Grassy Habitat. Other states in addition to Indiana actually had a net movement to Grassy Habitat for several land use categories. Of the eight possible net changes from Habitat, two had a net movement to Grassy Habitat in Indiana.

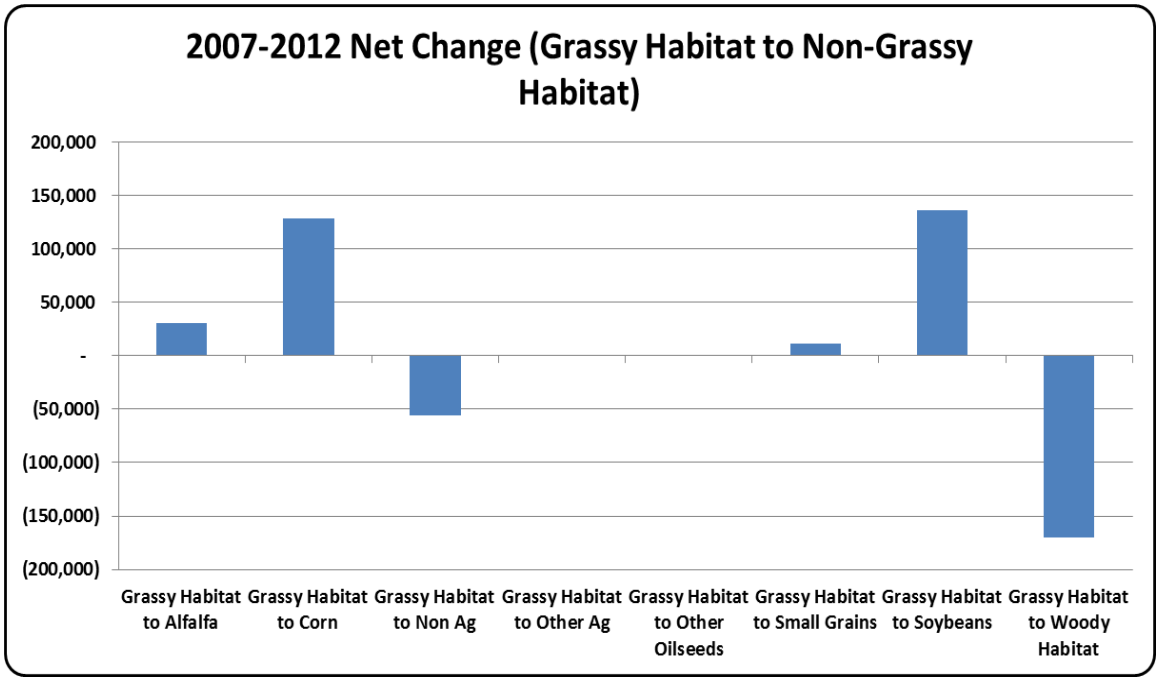


Figure 48, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Indiana

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	30,834
Grassy Habitat to Corn	127,991
Grassy Habitat to Non Ag	(56,231)
Grassy Habitat to Other Ag	808
Grassy Habitat to Other Oilseeds	-
Grassy Habitat to Small Grains	10,950
Grassy Habitat to Soybeans	136,234
Grassy Habitat to Woody Habitat	(170,574)
Net Change FROM Grassy Habitat	80,013

Table 28, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Indiana

Table 29 shows, in descending order of degree to which changes occurred by land use type, a summary of our estimates for land use change in Indiana from 2007-2012. As shown in Table 29, the total net change in Grassy Habitat across the Indiana study area was 80 thousand acres. This represents 0.3 percent of total land in the Indiana. While quite small in comparison to other states experiencing a net change from Grassy Habitat, the majority of this net change from Grassy Habitat was from Soybeans

(136 thousand acres) and Corn (128 thousand acres). Interestingly, there was a moderate shift of Woody Habitat toward Grassy Habitat. A likely explanation for this movement is due to natural changes in land characteristics from the end points of the study period (2007 and 2012). Figure 49 shows annual totals for each land use category for the Indiana study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Soybeans	136,234
Grassy Habitat to Corn	127,991
Grassy Habitat to Alfalfa	30,834
Grassy Habitat to Small Grains	10,950
Grassy Habitat to Other Ag	808
Grassy Habitat to Other Oilseeds	-
Grassy Habitat to Non Ag	(56,231)
Grassy Habitat to Woody Habitat	(170,574)
Net Change FROM Grassy Habitat	80,013

Table 29, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): Indiana

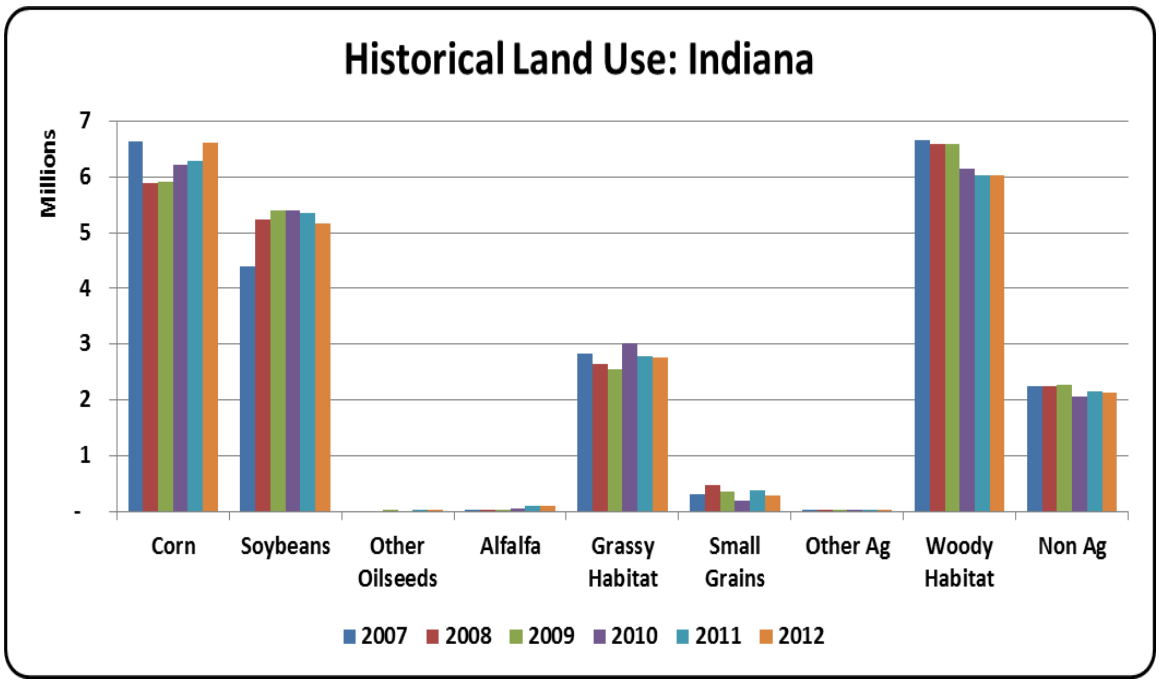


Figure 49, Historical Land Use: Indiana

Observations

Due to the relatively low acreage of Other Oilseeds and Other Ag within Indiana, we did not anticipate much of a shift from Grassy Habitat to these land use categories. However, given the degree to which Indiana produces Corn and Soybeans, we did suspect there would be a shift toward these land use categories.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed "program crops". This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 50-51 and Table 30. On a net basis, an estimated total of 0.275 million acres have shifted from the Grassy Habitat land use category to a combination of Corn, Soybeans, and Small Grains. This represents 1.2 percent of total land in principal field crops in Indiana. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the Indiana Results section.

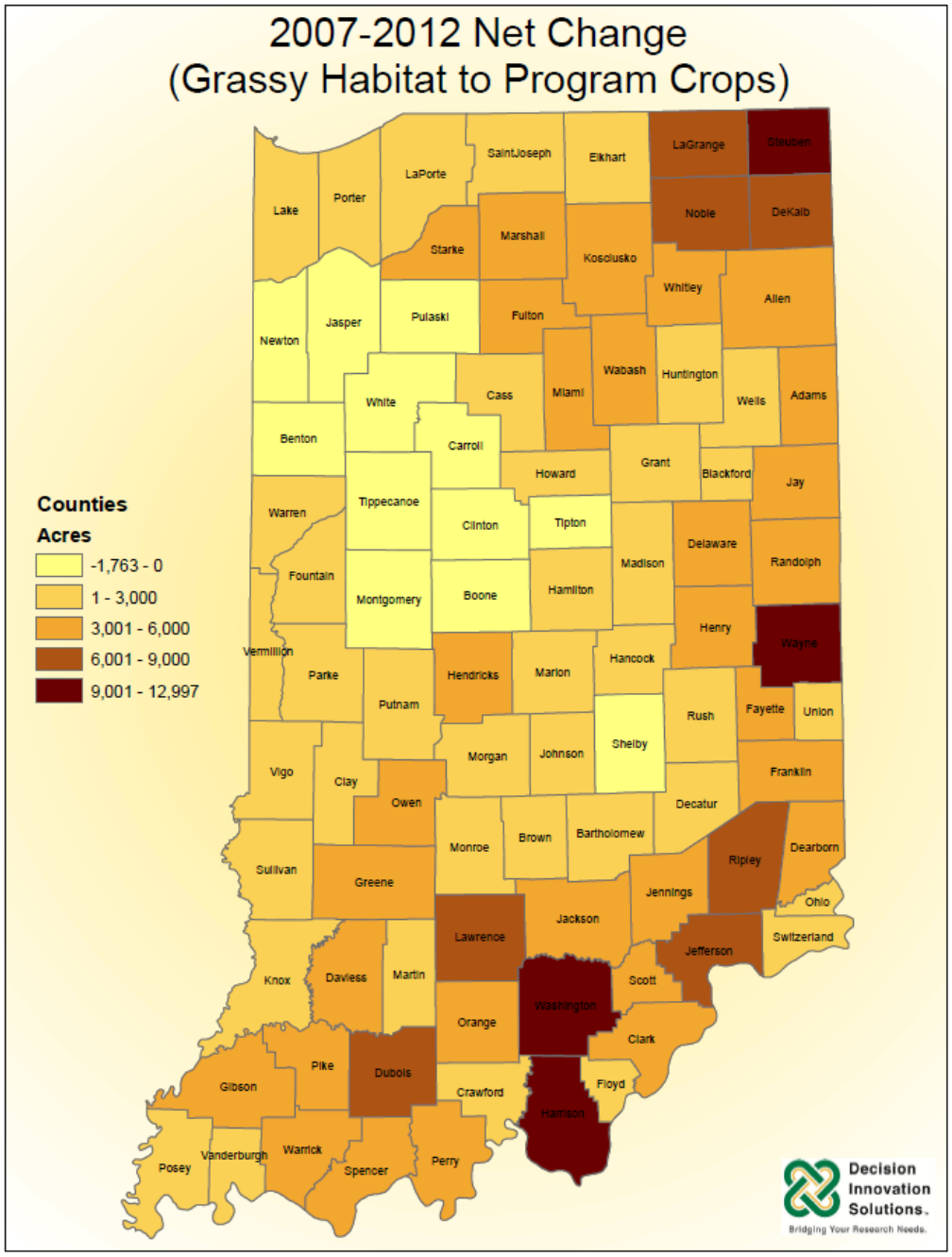


Figure 50, 2007-2012 Net Change (Grassy Habitat to Program Crops): Indiana Counties

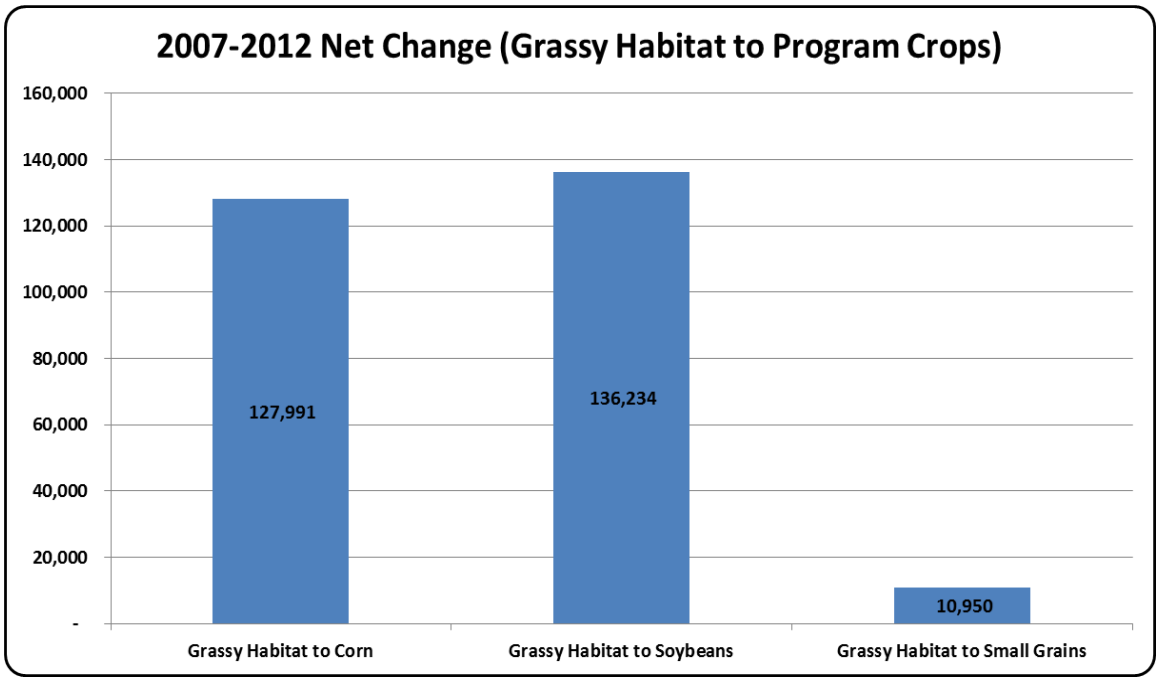


Figure 51, 2007-2012 Net Change (Grassy Habitat to Program Crops): Indiana

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	127,991
Grassy Habitat to Soybeans	136,234
Grassy Habitat to Small Grains	10,950
Total Net Change to Program Crops	275,175

Table 30, 2007-2012 Net Change (Grassy Habitat to Program Crops): Indiana

Econometric Results

Table 31 provides results for Indiana. A summary of econometric results with regard to the explanatory variables for Indiana is provided below.

- **Crop Insurance Subsidies**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Crop Insurance Subsidy, the higher the share of land devoted to Grassy Habitat.
- **Net Returns**
  - Variable is insignificant at the 95% level, but exhibits the expected sign (-).
    - Due to insignificance, no explanatory power is gleaned from the Net Returns variable with regards to its impact on the share of land devoted to Grassy Habitat.

- **Growing Degree Days**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Growing Degree Days, the higher the share of land devoted to Grassy Habitat.
- **Precipitation**
  - Variable is insignificant at the 95% level, but exhibits the expected sign (-).
    - Due to insignificance, no explanatory power is gleaned from the Net Returns variable with regards to its impact on the share of land devoted to Grassy Habitat.

Table 31, Econometric Results: Indiana

OLS Regression Statistics for GrassHab Ratio, 6/20/2013 6:11:06 PM					
F-test	13.192	Prob(F)	0.000	Unrestricted Model	
MSE1/2	0.075	CV Regr	61.169	F-test	13.192
R2	0.088	Durbin-Watson	1.690	R2	0.088
RBar2	0.081	Rho	0.155	RBar2	0.081
Akaike Information Criterion	-5.170	Goldfeld-Quandt	1.405	Akaike Information Cr	-5.170
Schwarz Information Criterion	-5.139			Schwarz Information C	-5.139
95%	Intercept	CIS	RET	GDD	Precip
Beta	0.002	**0.003**	0.000	**0.077**	-0.025
S.E.	0.035	0.000	0.000	0.033	0.016
t-test	0.065	5.843	-1.538	2.334	-1.580
Prob(t)	0.948	0.000	0.125	0.020	0.115
Elasticity at Mean		0.605	-0.048	0.628	-0.203
Variance Inflation Factor		1.376	1.351	1.398	1.384
Partial Correlation		0.242	-0.066	0.099	-0.067
Semipartial Correlation		0.238581278	-0.062800652	0.095296091	-0.064514255
Restriction					

The model for explaining changes in land devoted to Grassy Habitat in Indiana did not perform well. No explanatory variable exhibited both significance and the expected sign. Possible explanations for this likely include the underlying spatial characteristics (landscape changes spatially from north to south) at work in Indiana and the model may have difficulty explaining the relatively low (when compared to other states in the study area) net change from Grassy Habitat. Further, the overstatement of grassland by CDL issue explored earlier may also be confounding these results.

MICHIGAN

Background

In terms of a historical perspective on the land use in Michigan, acreage in farms for the area has ranged from a low of 6.4 million acres in 2009 to a high of 7.0 million acres in 1994. Estimated acreage devoted to principal field crops (corn, soybeans, dry beans, fruit bearing trees, many vegetables, sugar beets, potatoes, hay, and oats) in 2012 (6.7 million acres) is the ninth highest total since 1993, the first year data of this type were available. Acres devoted to principal field crops in 2012 represent 18.3 percent of land acres in Michigan. Referring to Figure 52, not since 2007 has there been similar acreage devoted to the planting of field crops in Michigan.

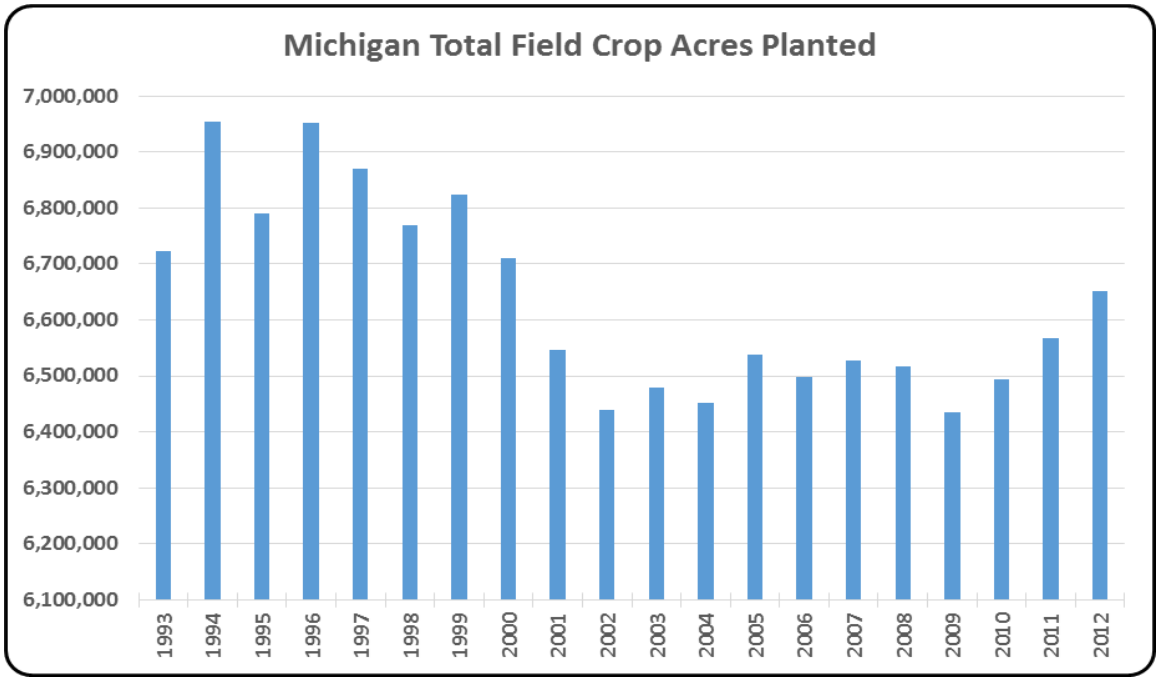


Figure 52, Michigan Total Field Crop Acres Planted

Referring to Figure 53, participation in the CRP program in Michigan is similar to Indiana. Neither of these states has had as many acres enrolled in the CRP program as other states such as Nebraska, Iowa, and Illinois. In 1996 the acres enrolled reached 0.335 million. Since the drop off in acres around 1998 and 1999, there was a small jump in 2002 and 2003, but acreage has since decreased to 0.222 in 2012. Michigan acres enrolled in the CRP program in 2012 represent 3.3 percent of total farmland in principal crops in the state.

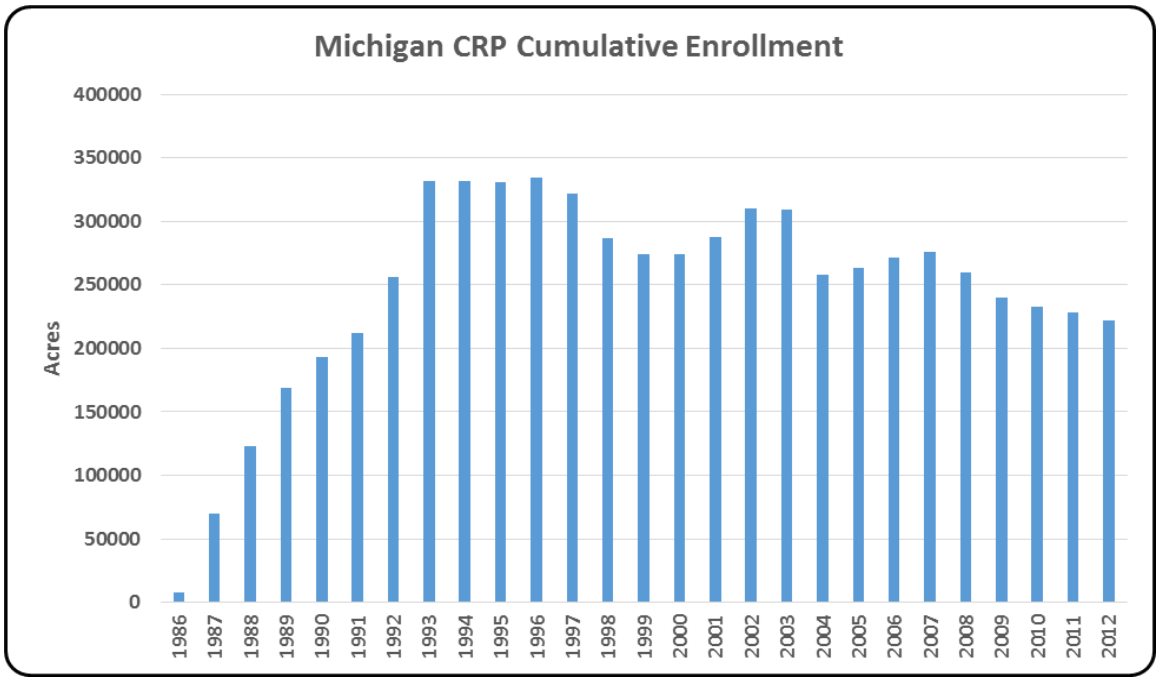


Figure 53, Michigan CRP Cumulative Enrollment

Spatial Results

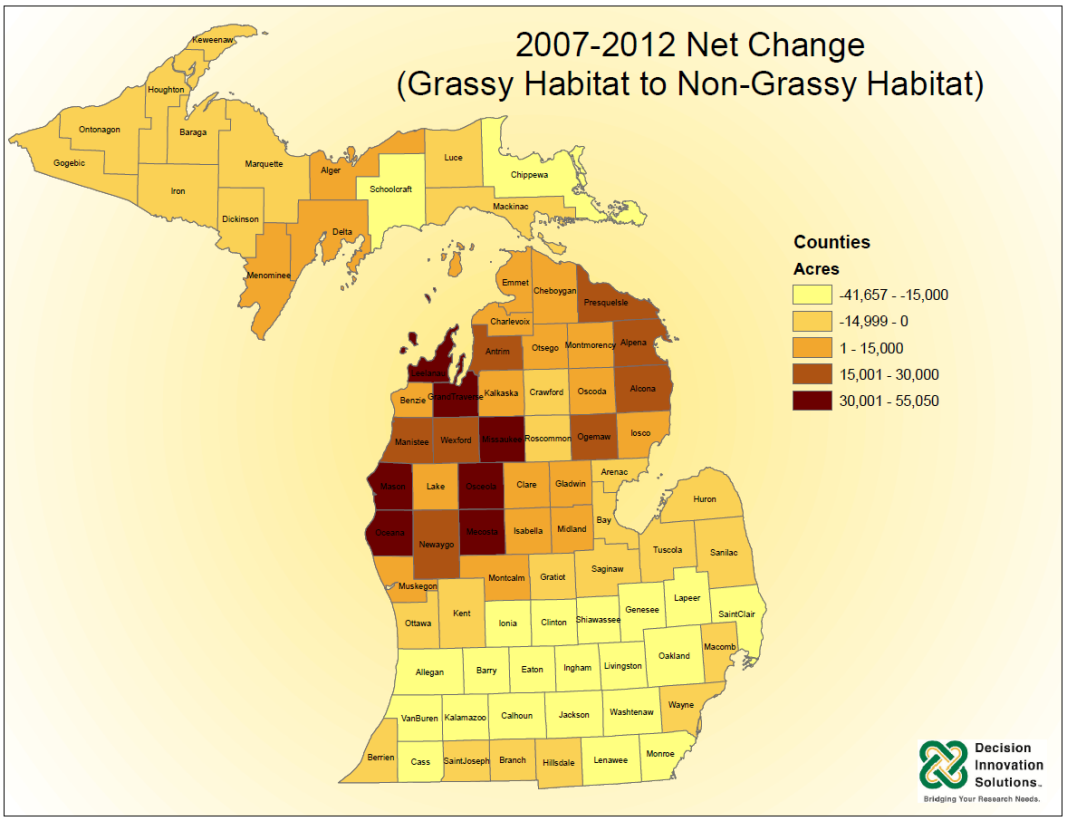


Figure 54, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Michigan Counties

Referring to Figures 54-55 and Table 32, the spatial analysis for the Michigan study area yielded some interesting results in terms of the degree to which the net change in habitat occurred across the study area from 2007-2012. In contrast to all other states in the study area, there was a small, but positive net land use change to the Grassy Habitat land use category to other categories. The majority of this net land use change to Grassy Habitat was from Woody Habitat and Non-Ag land use categories.

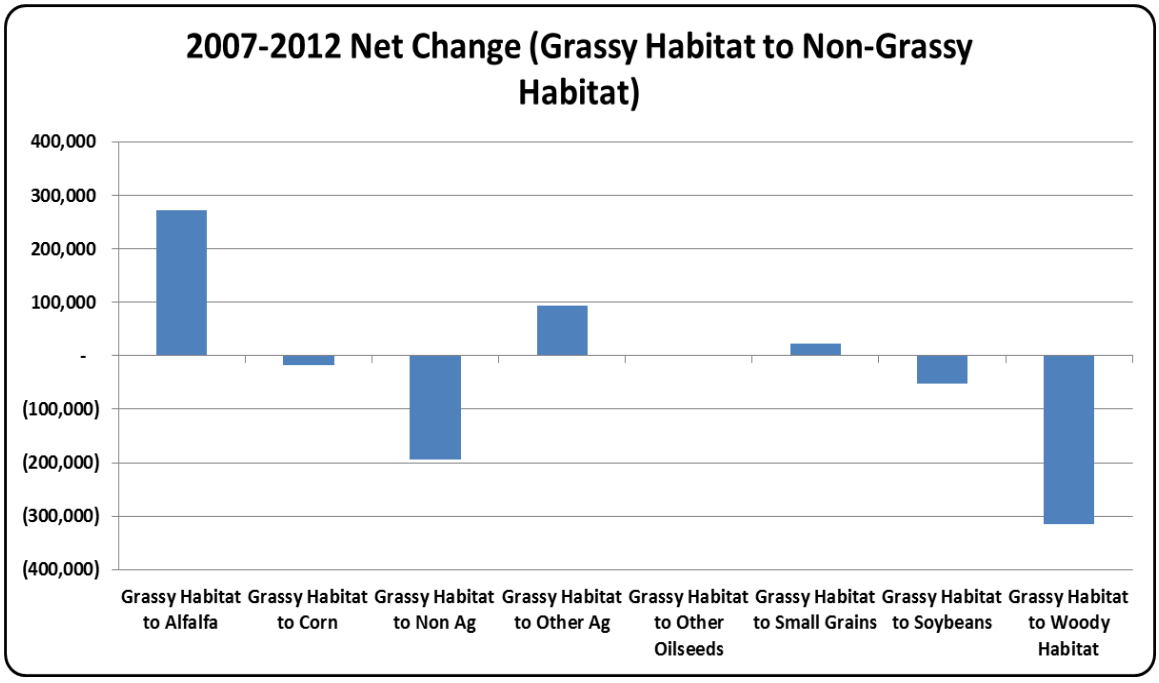


Figure 55, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Michigan

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	271,467
Grassy Habitat to Corn	(17,328)
Grassy Habitat to Non Ag	(194,757)
Grassy Habitat to Other Ag	93,026
Grassy Habitat to Other Oilseeds	350
Grassy Habitat to Small Grains	23,631
Grassy Habitat to Soybeans	(51,702)
Grassy Habitat to Woody Habitat	(314,393)
Net Change FROM Grassy Habitat	(189,706)

Table 32, 2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat): Michigan

Table 33 shows, in descending order of degree to which changes occurred by land use type, a summary of our estimates for net land use change in Michigan from 2007-2012. As shown in Table 33, the total net change (increase) in Habitat acreage across the Michigan study area was 190 thousand acres. This

represents 0.5 percent of total land in the Michigan. The majority of this net land use change to Grassy Habitat was from Woody Habitat (0.314 million acres), followed by Non-Ag (0.195 million acres). Interestingly, there was a moderate shift of Woody Habitat toward Grassy Habitat. A likely explanation for this movement is due to natural changes in land characteristics from the end points of the study period (2007 and 2012). Also, it should be noted that nearly all counties in the four southern tiers of counties in Michigan had net gains in Grassy Habitat during the study period. Figure 56 shows annual totals for each land use category for the Michigan study area.

2007-2012 Net Change (Grassy Habitat to Non-Grassy Habitat)	Net Change
Grassy Habitat to Alfalfa	271,467
Grassy Habitat to Other Ag	93,026
Grassy Habitat to Small Grains	23,631
Grassy Habitat to Other Oilseeds	350
Grassy Habitat to Corn	(17,328)
Grassy Habitat to Soybeans	(51,702)
Grassy Habitat to Non Ag	(194,757)
Grassy Habitat to Woody Habitat	(314,393)
Net Change FROM Grassy Habitat	(189,706)

Table 33, 2007-2012 Ranked Net Change (Grassy Habitat to Non-Grassy Habitat): Michigan

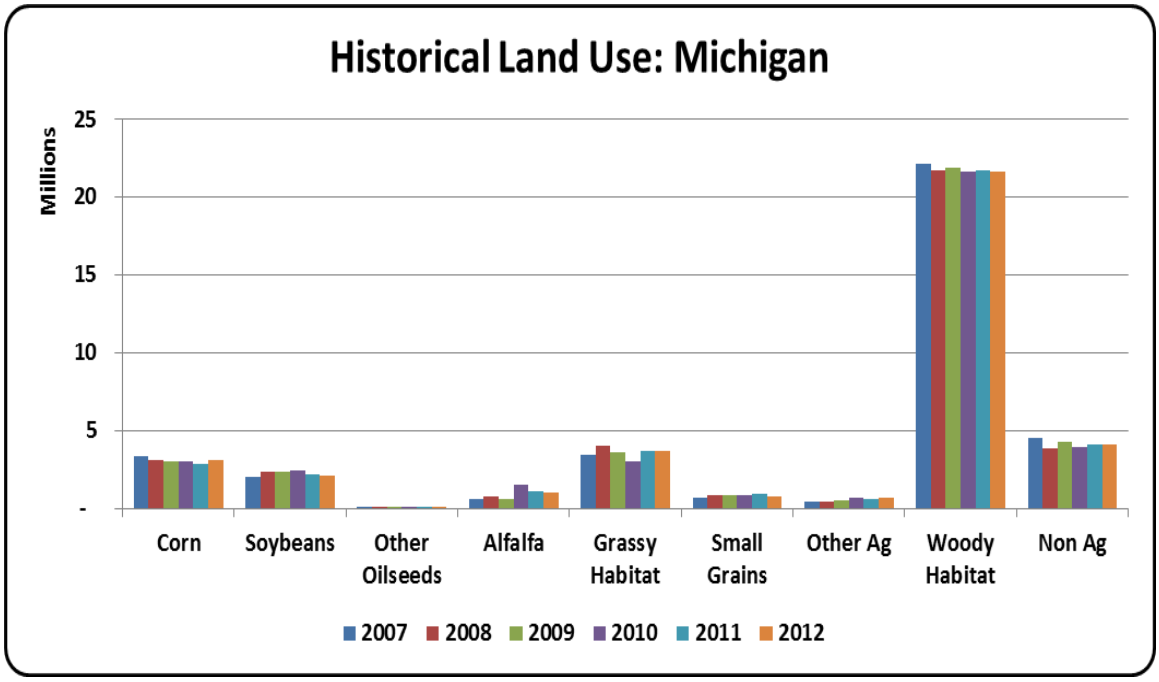


Figure 56, Historical Land Use: Michigan

Observations

We did not anticipate much of a shift from Grassy Habitat to Other Oilseeds and Other Ag within Michigan. As suspected, our estimates suggest that there were shifts of Grassy Habitat acreage toward Alfalfa. Surprising was the lack of movement to Corn and Soybeans in Michigan given that the net returns for corn and soybeans in Michigan are not that different from the returns for those crops in the other states within the study area.

Farm Policy

Because part of the econometric analysis addresses the concern that farm policy has contributed to loss of habitat, we have provided a subset of results for what may be termed "program crops". This subset includes: Corn, Soybeans, and Small Grains. These results are shown in Figures 57-58 and Table 34. On a net basis, an estimated total of 45 thousand acres have shifted to the Grassy Habitat land use category from a combination of Corn, Soybeans, and Small Grains. This represents 0.1 percent of total land in principal field crops in Michigan. Total net land use changes in Michigan from Grassy Habitat to Corn, Soybeans, and Small Grains was the only state in the 7-state study area which saw a net movement of the combination of these crops to Grassy Habitat. Additional context regarding the degree, if any, to which farm policy has influenced land use changes is discussed in the Econometric Analysis sub-section of the Michigan Results section.

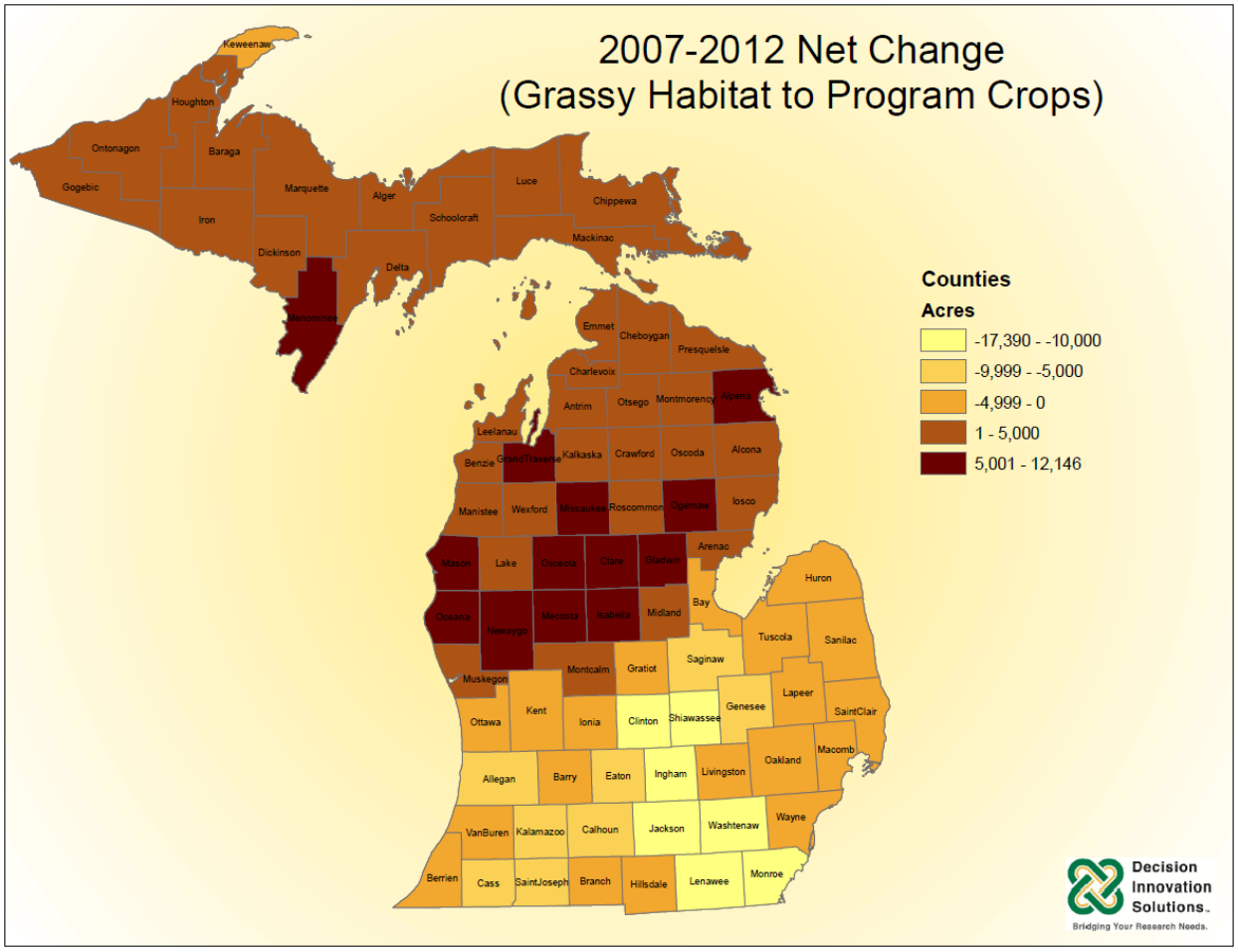


Figure 57, 2007-2012 Net Change (Grassy Habitat to Program Crops): Michigan Counties

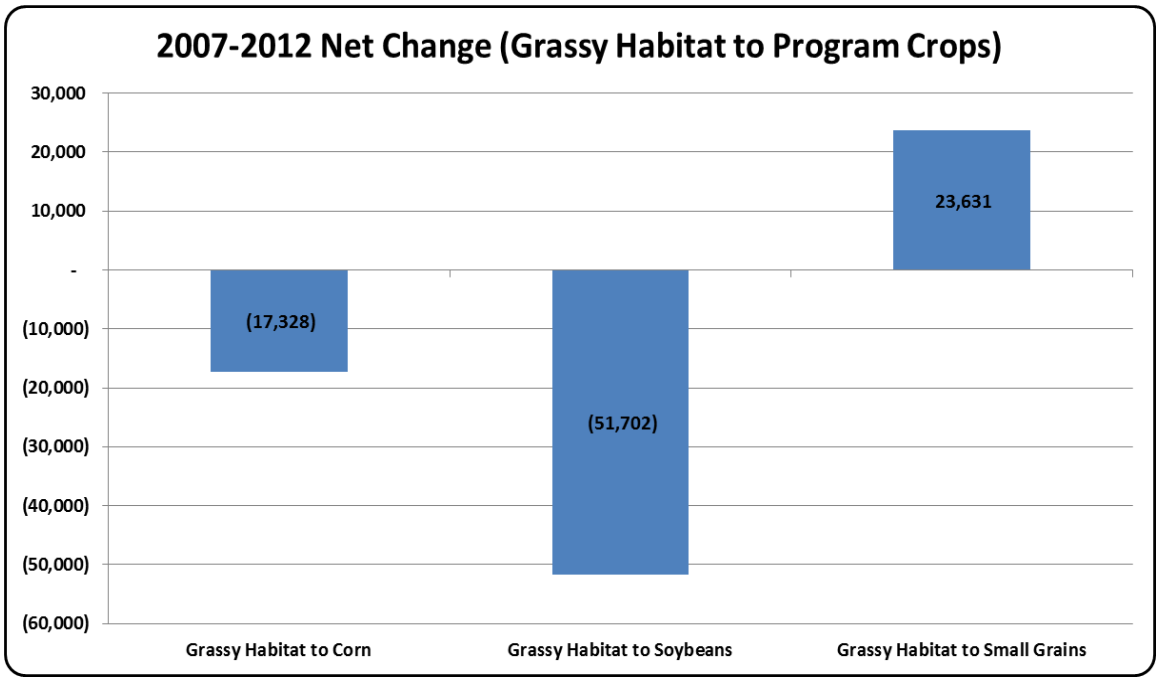


Figure 58, 2007-2012 Net Change (Grassy Habitat to Program Crops): Michigan

2007-2012 Net Change (Grassy Habitat to Program Crops)	Net Change
Grassy Habitat to Corn	(17,328)
Grassy Habitat to Soybeans	(51,702)
Grassy Habitat to Small Grains	23,631
Total Net Change to Program Crops	(45,398)

Table 34, 2007-2012 Net Change (Grassy Habitat to Program Crops): Michigan

Econometric Results

Table 35 provides results for Michigan. A summary of econometric results with regard to the explanatory variables for Michigan is provided below.

- **Crop Insurance Subsidies**
  - Variable is insignificant at the 95% level, but exhibits the expected sign (-).
    - Due to insignificance, no explanatory power is gleaned from the Crop Insurance Subsidies variable with regards to its impact on the share of land devoted to Grassy Habitat.
- **Net Returns**
  - Variable is insignificant at the 95% level, but exhibits the expected sign (-).

- Due to insignificance, no explanatory power is gleaned from the Net Returns variable with regards to its impact on the share of land devoted to Grassy Habitat.

- **Growing Degree Days**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Growing Degree Days, the higher the share of land devoted to Grassy Habitat.
- **Precipitation**
  - Variable is significant at the 95% level, but *does not* exhibit the expected sign (-).
    - Result suggests that the higher the Precipitation, the higher the share of land devoted to Grassy Habitat.

Table 35, Econometric Results: Michigan

OLS Regression Statistics for GrassHab Ratio, 6/20/2013 6:01:44 PM					
F-test	13.540	**Prob(F)**	0.000	**Unrestricted Model**	
MSE1/2	0.051	**CV Regr**	49.298	**F-test**	13.540
R2	0.099	**Durbin-Watson**	2.204	**R2**	0.099
RBar2	0.092	**Rho**	-0.103	**RBar2**	0.092
Akaike Information Criterion	-5.951	**Goldfeld-Quandt**	1.662	**Akaike Information Cr**	-5.951
Schwarz Information Criterion	-5.917			**Schwarz Information C**	-5.917
95%	**Intercept**	**CIS**	**RET**	**GDD**	**Precip**
Beta	-0.006	0.000	0.000	**0.065**	**0.055**
S.E.	0.020	0.000	0.000	0.019	0.014
t-test	-0.289	-1.278	-1.557	3.473	3.994
Prob(t)	0.773	0.202	0.120	0.001	0.000
Elasticity at Mean		-0.064	-0.043	0.631	0.533
Variance Inflation Factor		1.254	2.005	1.932	1.236
Partial Correlation		-0.057	-0.070	0.155	0.177
Semipartial Correlation		-0.054644794	-0.066548128	0.148454227	0.170766049
Restriction					

The model results for Michigan are mixed, both in terms of significance and type of impact (expected sign). A possible explanation for unexpected signs for Growing Degree Days and Precipitation lies in how Michigan's landscape changes spatially. Additionally, the landscape in the Upper Peninsula is largely more forested than the rest of the state, which typically does not experience much land use change. Additionally, the model is likely having difficulty explaining a net movement *to* Grassy Habitat, which is something that only occurred in Michigan. Further, the "overstatement of grassland by CDL" issue explored earlier may also be confounding these results.

Research Implications/Suggestions for Further Research

The 2013 Multi-State Land Use study yielded many interesting results with policy implications. Additionally, the results have led to questions that could be the subject of additional research in the realm of understanding Midwestern land use patterns. The primary purpose of the 2013 Multi-State Land Use study was to: 1) provide estimates of the degree to which land use changes have occurred in seven of twelve Midwestern states; and 2) identify potential factors contributing to these land use changes.

Spatial Implications

Without question, our spatial analysis yielded results that support the perception that land use continues to evolve in the Midwest, just as it has done for centuries. In our research we found the assumption by some regarding the large degree to which net land use changes away from habitat as a foregone conclusion is not entirely accurate, especially on a regional basis. When looking at various states and/or sub-Midwestern regions, certain areas exhibited more net land use change away from Grassy Habitat than others. South Dakota and Nebraska are examples of this type of net land use change away from Grassy Habitat.

On the contrary, many states showed very low net movement from Grassy Habitat (Illinois and Indiana) or, in one case (Michigan), a net increase in habitat acreage. In our assessment, this marks a significant departure from the belief that all areas in the Midwest are suffering net losses in Grassy Habitat. Our spatial results stand in direct conflict to this assumption.

In using an aggregated measure such as “Net Land Use Change (Grassy Habitat to Non-Grassy Habitat)”, certain types of land use changes can be masked, particularly when the change is within a land use category. As explained, aggregation was done in such a way to minimize the effects of either misclassified land cover types by the CDL data and/or improvement in remote sensing technology.

One of the key findings of this research with regards to spatial implications is the degree of value gained from using CDL data for decision making. While the data have been improving over time and continues to increase its ability to guide the policy decision making process, there are still errors in how certain types of land covers are identified, particularly those which are either comparatively observed less frequently or are more grassy in nature. To base policy decision solely upon results from CDL data can lead to less than optimal outcomes with regard to land use patterns.

Econometric Implications

Surprisingly, the econometric results associated with this study showed that the majority of states in the study area were not significantly impacted by crop insurance subsidies. However, two states (South Dakota and Nebraska) showed that some areas within the state were susceptible to moving from Habitat to other uses, particularly toward what can be referred to as "Program Crops". While we did not specifically test it in this analysis, we suspect the reason for a shift from Grassy Habitat acres to other uses is due to crop insurance reducing the risk of producing crops in areas more prone to adverse climate variables such as infrequent or limited precipitation and/or more susceptibility to frost conditions. In states such as Iowa, Illinois, Indiana, and certain portions of South Dakota and Nebraska, these variables do not appear to have the same impact.

Almost without exception, precipitation and growing degree days were statistically significant variables when explaining the share of acreage devoted to Grassy Habitat, but in some cases exhibited an unexpected sign. While this result was expected, something worth considering is what would be the impact of a reduction or even unavailability of water in those states that are heavily reliant upon irrigation. Those crop producers who irrigate, no doubt, factor the costs of irrigation when considering an alteration of traditional crop rotations.

A key finding of this research with regards to econometric implications is that land use is a very complex issue that cannot be reduced to a few variables. In particular, our economic research does not support the notion that crop insurance subsides and net returns alone are the dominant factors contributing to loss of Grassy Habitat, especially when observed from a regional perspective.

Suggestions for Further Research

Change in Traditional Growing Areas

As the traditional growing area for corn and soybeans continues to expand west and north in an elevated return situation, how "durable" are these acres with regard to the ability to consistently be used for producing these crops, especially if marginal returns to crop producers return to more historical levels? At what point do these acres revert to their use prior to increases in net returns? If the land use immediately prior to producing crops was CRP, will these acres be resubmitted for enrollment?

Elevated Commodity Prices

Additional research regarding the cause(s) of higher commodity prices and resulting net returns is a topic worthy of additional consideration. Because our results suggest crop production economics have

significant influence on the decision to produce crops, returns from competing land use options will have influence on responsible land owners' decision making process.

CRP Decision

Because of the nature and degree to which CRP has influence on land use decisions, the topic of CRP has been an integral component to this research. For the foreseeable future, CRP will continue to be viewed as an alternative land use to crop production. However, whole farm signups have and will continue to give way to more targeted land conservation programs and/or land stewardship techniques. Given the degree to which technological and agronomic advances have been made since CRP was first implemented in 1986, we would expect the popularity of either federal programs such as the Continuous CRP and other state level incentives to increase. Furthermore, there seems to be some evidence (such as seen in southern Michigan and north central Iowa) that a more targeted implementation of CRP for water quality and wildlife habitat purposes is resulting in less grasslands in those areas that dominated the sign-ups in the early years of the CRP program and more grasslands, despite higher crop returns and increased crop insurance subsidies in some of the major crop production counties.

Change in Study Area Definition

One finding from this research has been that landscape had implications for econometric results. Within each state are different types of landscape. For example, Nebraska exhibits large changes in precipitation from west to east, Illinois has large difference in growing degree days from north to south, and Iowa landscapes becomes more hilly as one moves south. While not certain, we believe this has had implications for econometric results being either insignificant and/or exhibiting the incorrect sign. Additional research in this area may benefit from study areas not confined to political boundaries such as states. At the least, additional insight may be gained from an analysis based on groups of crop reporting districts without regard to state, as defined by USDA and to use additional variables such as land classification criteria.

Appendix A, Land Use Types

Corn

"1"	Corn
"4"	Sorghum
"12"	Sweet Corn
"13"	Pop or Ornamental Corn

Soybeans

"5"	Soybeans

Other Oilseeds

"6"	Sunflower
"31"	Canola
"32"	Flaxseed
"33"	Safflower
"34"	Rape Seed
"35"	Mustard

Alfalfa

"36"	Alfalfa

Grassy Habitat

"37"	Other Hay/Non Alfalfa
"62"	Pasture/Grass
"87"	Wetlands
"171"	Grassland Herbaceous
"181"	Pasture/Hay
"195"	Herbaceous Wetlands

Woody Habitat

"63"	Forest
"64"	Shrubland
"141"	Deciduous Forest
"142"	Evergreen Forest
"143"	Mixed Forest
"152"	Shrubland
"190"	Woody Wetlands

Small Grains

"21"	Barley
"22"	Durum Wheat
"23"	Spring Wheat
"24"	Winter Wheat
"25"	Other Small Grains
"26"	Dbl Crop Winter Wheat/Soybeans

"27"	Rye
"28"	Oats
"29"	Millet
"30"	Speltz
"61"	Fallow/Idle Cropland

Other Ag

"2"	Cotton
"3"	Rice
"10"	Peanuts
"11"	Tobacco
"14"	Mint
"38"	Camelina
"39"	Buckwheat
"41"	Sugarbeets
"42"	Dry Soybeans
"43"	Potatoes
"44"	Other Crops
"45"	Sugarcane
"46"	Sweet Potatoes
"47"	Misc Vegs & Fruits
"48"	Watermelons
"49"	Onions
"50"	Cucumbers
"51"	Chick Peas
"52"	Lentils
"53"	Peas
"54"	Tomatoes
"55"	Caneberries
"56"	Hops
"57"	Herbs
"58"	Clover/Wildflowers
"59"	Sod/Grass Seed
"60"	Switchgrass
"66"	Cherries
"67"	Peaches
"68"	Apples
"69"	Grapes
"70"	Christmas Trees
"71"	Other Tree Crops
"72"	Citrus
"74"	Pecans
"75"	Almonds
"76"	Walnuts
"77"	Pears
"92"	Aquaculture
"204"	Pistachios
"205"	Triticale

"206"	Carrots
"207"	Asparagus
"208"	Garlic
"209"	Cantaloupes
"210"	Prunes
"211"	Olives
"212"	Oranges
"213"	Honeydew Melons
"214"	Broccoli
"216"	Peppers
"217"	Pomegranates
"218"	Nectarines
"219"	Greens
"220"	Plums
"221"	Strawberries
"222"	Squash
"223"	Apricots
"224"	Vetch
"225"	Dbl Crop Winter Wheat/Corn
"226"	Dbl Crop Oats/Corn
"227"	Lettuce
"229"	Pumpkins
"230"	Dbl Crop Lettuce/Durum Wheat
"231"	Dbl Crop Lettuce/Cantaloupe
"232"	Dbl Crop Lettuce/Cotton
"233"	Dbl Crop Lettuce/Barley
"234"	Dbl Crop Durum Wheat/Sorghum
"235"	Dbl Crop Barley/Sorghum
"236"	Dbl Crop Winter Wheat/Sorghum
"237"	Dbl Crop Barley/Corn
"238"	Dbl Crop Winter Wheat/Cotton
"239"	Dbl Crop Soybeans/Cotton
"240"	Dbl Crop Soybeans/Oats
"241"	Dbl Crop Corn/Soybeans
"242"	Blueberries
"243"	Cabbage
"244"	Cauliflower
"245"	Celery
"246"	Radishes
"247"	Turnips
"248"	Eggplants
"249"	Gourds
"250"	Cranberries
"254"	Dbl Crop Barley/Soybeans

All Non-Ag

"65"	Barren
"81"	Clouds/No Data

"82"	Developed
"83"	Water
"88"	Nonag/Undefined
"111"	Open Water
"112"	Perennial Ice/Snow
"121"	Developed/Open Space
"122"	Developed/Low Intensity
"123"	Developed/Med Intensity
"124"	Developed/High Intensity
"131"	Barren